



Department for Electrical Engineering and Information Technology

Study Regulations

for the master program

Medical Systems Engineering

from November 1, 2006

as amended on February 1, 2012

**!!!This document is only for information.
The German version is legally binding!!!**

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§ 1 area of application

(1) On the basis of the examination regulations, the present study regulations specify the aim, the content and the structure of the master study course

“Medical Systems Engineering”

in the Department for Electrical Engineering and Information Technology (FEIT) of the Otto-von-Guericke-University Magdeburg in cooperation with the Department for Mechanical Engineering, the Department for Informatics, the Department for Chemical Engineering and Systems Engineering, the Department for Mathematics, the Department for Natural Sciences, the Medical Department as well as the Leibniz Institute for Neurobiology.

(2) This master study course is a consecutive course of the profile type "more research oriented". There are strong links to applications in this course.

(3) The study course is accomplished as a full-time and on-campus program.

§ 2 purpose of the study

(1) The purpose of the study is to acquire detailed knowledge, to introduce the theoretical and applied aspects of the study course and to enable scientific work, particularly with the aim of subsequently doing a PhD. In doing so, the ability should be gained to independently get acquainted with the manifold challenges of applied, research-related and teaching-related fields of activity and to cope with the frequently changing tasks of a manager and a scientist. Besides the acquisition of knowledge and the development of abilities in the various types of courses, self-study is essential for the successful final degree.

(2) In addition to the general purpose, the study course contains further specific purposes:

professional competencies: the alumni

- have a profound professional knowledge in the field of modern medical engineering and medical informatics, particularly of the technologies for diagnostics and therapy
- have a basic understanding of medicine and are in a position to interpret medical problems into technological needs
- have an overview of the demands of the medical science made on the natural sciences and the technology
- are able to conceive technical systems adapted from the medical needs and to implement them in cooperation with industrial partners
- understand the burden and adverse effects of technologies on the human body and have an overview about the legal prerequisites
- know organizational and documentation structures of the health care system
- have a profound professional knowledge in the field of modelling medical, physiological and cognitive systems, particularly in the area of the brain sciences
- are in a position to independently solve scientific problems by appropriate methods and to present the results of their work both in the science and in the popular science via various media (journals, oral presentation, internet)

- are prepared on the basis of their expertise for a flexible assignment in different occupational areas such as medical engineering, biotechnology and medical informatics
- have an overview about the current scientific topics of the medical engineering and are prepared for a further scientific career (e.g. PhD)

social competencies: the alumni

- are qualified to communicate with experts also in foreign languages about the content and problems of medical technology and biotechnology as well as medical informatics
- are aware in their actions of their social and ethical responsibility
- are fit to work individually and as a member of international groups
- are prepared for the professional life especially in the industry as a result of the highly practical component of the study course and are prepared for the academic research due to their scientific competencies
- can comprehend complex and interrelated structured plans and can professionally realize their implementation with methods of project management while taking into account economic aspects

occupational fields: the termination of this master particularly qualifies the alumni for these vocational fields:

- development engineer in the medical engineering industry
- computer scientist in a hospital, health service management in the medical industry
- developer of intelligent human-machine interfaces, i.e. multimodal operation of devices, user-adaptive control
- scientist in the industrial, academic and clinical research in medical engineering and informatics, biotechnology and neuroscience
- consultant for embedded medical systems and plants
- product management and sales of medical systems and plants
- independence in the area of medical engineering and medical informatics

§ 3 degree

(1) After successfully passed examinations the Otto-von-Guericke-University awards the academic degree

“Master of Science”
abbreviated: **“M.Sc.”**

§ 4 prerequisites for admission

(1) The prerequisite for admission to this master study course is proof of one of the following degrees from the application area of the Framework Act for Higher Education:

- a bachelor degree, master degree or diploma degree acquired at a university or technical university in electrical engineering, information technology, informatics, mechanical engineering, chemical engineering (or comparable degrees) with a grade of at least “good”
- a master degree or diploma degree acquired at a university of applied sciences in electrical engineering, information technology, informatics, mechanical engineering, chemical engineering (or comparable degrees) with a grade of at least “very good”

(2) About the admission with comparable degrees according to section 1 or degrees which have not been acquired within the application area of the Framework Act for Higher Education or in other exceptional cases the examination board decides after verification of the individual case.

(3) language skills

- Courses are conducted in English. The students are therefore expected to have sufficient knowledge of English.
- Applicants have to prove sufficient knowledge of the English language. As a proof, one of the following certificates is accepted:
 - TOEFL (Test of English as a Foreign Language), at least 550 points (old test procedure) and 220 points respectively (computer procedure since 1998) or 80 points (internet based TOEFL)
 - IELTS (International English Language Testing System), number of points between 5.5 and 6.5
 - Cambridge Proficiency in English (A, B and C)
 - UNICert II (European level B2)
- If a candidate is unable to provide an appropriate certificate, in individual case, an approval under the condition is possible by handing in the certificate by the end of the second semester.

(4) The certificates and proofs have to be presented in German and English language, respectively, and in an appropriate translation by a certified interpreter.

(5) The study course is limited in admission. Details are regulated by the terms of reference.

§ 5 start and duration of the study

(1) The study course is created in a way that it can be finished within the regular period of study of 4 semesters including the master thesis with the colloquium. The course offering is in line with the start of the study in the summer semester.

§ 6 extent of the study

(1) The study effort of the student equates to 120 credit points for this period of time.

- (2) The successful pass of the examinations which can be seen in the examination schedule of the examination regulations and the production of the master thesis including the colloquium are necessary for the successful termination of the study course. The master thesis and the colloquium equate to an effort of 24 credit points. The thesis has to be submitted 20 weeks after its issue at the latest. Exceptions are discussed in the examination regulations.
- (3) The time-frame can be extracted from the regular degree program attached.

§ 7 contents of the study

- (1) The information required for the successful completion of the course modules, including module tests, are stipulated in the examination regulations. The recommended distribution of the modules to the semesters are listed in the attached program study plan.
- (2) The study is available in two variants. The standard version is the "regular curriculum". Alternatively, students may take the "Research Track" version upon application. The Audit Committee decides on the approval.

Regular curriculum:

- The respective compulsory modules should be taken completely as per standard curriculum.
- The elective modules are combined and grouped into majors. Students must choose two majors from the entire range, each with a total of 15 credit points, so that specialization is achieved. The remaining compulsory credits can be freely selected from the entire range.
- Not all majors are offered in every semester. Furthermore, some majors are limited in number of participants. The elections of the majors are therefore limited to available offers during the semester and are possible depending on the available seats. The current offers will be announced each semester on the noticeboard and on the internet.

Research Track:

- The respective compulsory modules should be taken completely as per standard curriculum.
- The compulsory modules must be taken from the major "Bildgebung und Interventionen" with a total of 15 credit points. The remaining compulsory share can be freely selected from the entire range.
- Students must complete a research project either as part of studying abroad or at a company or research facility with the amount of 20 credit points. The research project must be requested to the Audit Committee in the form of a proposal. The Audit Committee will decide on acceptance.

(3) The examination achievements to be proven consist of the module examinations and the master thesis with the colloquium. The number and the type of exams are defined in the examination regulations. It will be tested course-related.

(4) The master thesis is an independent research work that has to be submitted in written form and has to be defended. In doing so the student should show that he or she is able to work independently on a problem of a specific area with scientific methods within a given period of time.

§ 8 structure of the study

- (1) The course offer contains compulsory modules, elective modules and optional modules. It is in the lecturers' responsibility to balance the different teaching methods of their modules in accordance with applicable regulations. Compulsory modules have to be taken completely.
- (2) All modules which are necessary for the successful termination of the study are named compulsory modules, according to the examination and study regulations.
- (3) All modules the students have to choose from a specific number of modules are named elective modules, in compliance with the examination and study regulations. Within the chosen field of study, they allow the student to follow individual propensities and interests and they account for expert requirements of the future field of activity. The list of elective modules is changed according to the capacity and availability of the lecturers and is adapted to the course offer of the faculty.
- (4) All modules which the students take at their own choice additional to the compulsory and elective modules (those which are necessary for the termination of the study course) and are from the course offer of this study course, according to the module list, are named optional modules. Other modules can be taken in consideration to their valid admission restrictions. The students can take a test in the optional modules. The result of this exam is not taken into account for fixing the final grade.
- (5) The registration for a desired elective subject or an optional subject has to be made in the first lecture after the start of the respective semester after clearance with the course adviser. If less than 5 students register for a module, the module and its specializations, to which the module is part of, can be cancelled. The person responsible for the modules informs the examination board. The examination board can announce another module as a substitute for the cancelled one, in this case the appropriate specialization can be chosen. If no substitute is announced, the specializations to which the module is part of is eliminated and the students have to choose other specializations according to clause (1).

For compelling reasons variations are possible, to which the examination board decides.

§ 9 types of courses

- (1) Lectures, seminars, tutorials, colloquia, laboratory internships, research projects and excursions, also in combination, are carried out.
- (2) Lectures put basic technical, theoretical and methodical knowledge across in a coherent and systematic presentation.
- (3) Seminars serve the purpose to elucidate theoretical problems which are related to practice in cooperation between lecturers and students. This can happen in exchanging work methods (presentation, seminar paper, theses preparation, discussion).
- (4) Tutorials help to acquire basic methods, abilities and skills.
- (5) The deepened scientific examination between lecturer and students to selected topics takes place in colloquia.
- (6) Excursions serve the purpose of collecting information to view and to make contact to the local practice.
- (7) Research projects support the development of abilities useful for the independent scientific work and the practice-oriented solution of integrated problems. They are performed in groups.

- (8) Laboratory internships help to reinforce the contents of the study due to a practical application.
- (9) Individual lectures with professors on special agreement.

§ 10 course advice

- (1) A course consultation is offered. Especially for questions regarding the course of study, the replacement of modules and for problems that considerably exceed the time-limit for a regular period of study, the consultation is strongly recommended.
- (2) The consultation is mandatory for fixing the major fields of study.
- (3) For every student, a mentor as a contact person for questions about the study and the teaching is placed at disposal.

§ 11 temporary arrangement

This statute applies to all students who begin the studies in summer term 2012.

§ 12 coming into effect

These study regulations come into effect on the day after the announcement in the Administrative Handbook to all students and employees of the Otto-von-Guericke-University.

Written on the basis of the decisions made by the faculty board of the Department for Electrical Engineering and Information Technology from February 1, 2012 and on the basis of the decisions made by the Academic Senate of the Otto-von-Guericke-University from March 21, 2012.

Magdeburg, March 28, 2012

Prof. Dr. K. E. Pollmann
Rector of the Otto-von-Guericke-University Magdeburg

General curriculum

Master program

Medical Systems Engineering



Explanation to the general curriculum:

- S** = semester hours (SWS)
- A** = Types of courses
 - V** = Lecture
 - S** = Seminar
 - Ü** = Tutorial
 - K** = Colloquium
 - LP** = Lab Project
 - PRO** = Research Project
 - E** = Field trip
 - *** = Depends on the chosen modules or not applicable
- CP** = Credit Points

Legende zum Regelstudienplan:

- S** = Semesterwochenstunden (SWS)
- A** = Art der Lehrveranstaltung
 - V** = Vorlesung
 - S** = Seminar
 - Ü** = Übung
 - K** = Kolloquium
 - LP** = Laborpraktikum
 - PRO** = Wissenschaftliches Projekt
 - E** = Exkursion
 - *** = Abhängig von der Modulwahl oder nicht zutreffend
- CP** = Credit Points = Leistungspunkte

General scheme

General scheme of the curriculum. The distribution of credit points within one depends on the chosen modules. The total workload is constant.

Regular curriculum	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Technical compulsory modules	30			14									44		
Methodical and social compulsory modules				5			6						11		
Elective modules - Deepening 1				5			10						15		
Elective modules - Deepening 2				5			10						15		
Elective modules from entire range							5						5		
Methodical colloquium and Master thesis										30			30		
	30 CP			29 CP			31 CP			30 CP			120 CP		

Research Track	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Technical compulsory modules	30			3									33		
Methodical and social compulsory modules				3			8						11		
Research Project				20									20		
Elective modules - Deepening "Imaging and Intervention"				5			10						15		
Elective modules from entire range							11						11		
Methodical colloquium and Master thesis										30			30		
	30 CP			31 CP			29 CP			30 CP			120 CP		

Detailed information about the modules can be found in the following charts.

Technical compulsory modules

Enrolment: All modules.

Regular curriculum	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Neuroanatomy for Engineering students	4	3	V/Ü										4	3	V/Ü
Biological Statistics	5	3	V/Ü										5	3	V/Ü
Medical Physics and Diagnostics	5												5		
<i>submodule: Introduction into Medical Imaging</i>		3	V/Ü											3	V/Ü
<i>submodule: Radiological Diagnostics</i>		1	V											1	V
Medical Measurement Technology	3			3									6		
<i>submodule: Chemical and Biological Sensors</i>		2	V											2	V
<i>submodule: Ultrasonic Sensors for Imaging</i>				2		V								2	V
Medical Informatics	4	3	V/Ü										4	3	V/Ü
Microsystems- and Nano-Technologies for Medical Solutions	5	3	V/Ü										5	3	V/Ü
Human Factors Engineering	4	2	S										4	2	S
Mathematical foundations				6	4	V/Ü							6	4	V/Ü
Digital Information Processing				5	3	V/Ü							5	3	V/Ü
	30 CP			14 CP									44 CP		

Research Track	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Neuroanatomy for Engineering students	4	3	V/Ü										4	3	V/Ü
Biological Statistics	5	3	V/Ü										5	3	V/Ü
Medical Physics and Diagnostics <i>submodule: Introduction into Medical Imaging</i> <i>submodule: Radiological Diagnostics</i>	5												5		
		3	V/Ü											3	V/Ü
		1	V											1	V
Medical Measurement Technology <i>submodule: Chemical and Biological Sensors</i> <i>submodule: Ultrasonic Sensors for Imaging</i>	3			3									6		
		2	V											2	V
				2		V								2	V
Medical Informatics	4	3	V/Ü										4	3	V/Ü
Microsystems- and Nano-Technologies for Medical Solutions	5	3	V/Ü										5	3	V/Ü
Human Factors Engineering	4	2	S										4	2	S
	30 CP			3 CP									33 CP		

Methodical and social compulsory modules

Enrolment: All modules.

Regular curriculum	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Scientific working <i>submodule: Scientific Ethics</i> <i>submodule: Journal Club (in winter semester)</i>				5	3	S							5	3	S
					2	S								2	S
					1	S								1	S
Entrepreneurship: Business Planning							6	3	V/Ü				6	3	V/Ü
				5 CP			6 CP						11 CP		

Research Track	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Scientific working <i>submodule: Scientific Ethics</i> <i>submodule: Journal Club (in summer semester)</i>				3	2	S	2	1	S				5	3	S
					2	S								2	S
								1	S					1	S
Entrepreneurship: Business Planning							6	3	V/Ü				6	3	V/Ü
							3 CP			8 CP			11 CP		

Research Project within Research Track

Enrolment: All modules.

	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Research Project				20									20		
				20 CP									20 CP		

Elective modules

Enrolment - regular curriculum: Choice of two deepening. Choice of modules with a total number of 15 CP per deepening. Choice of modules with a total number of 5 CP from the entire range in addition. Enrolment - Research Track: Choice of modules with a total number of 15 CP from the deepening "Imaging and Intervention". Choice of modules with a total number of 11 CP from the entire range in addition.

Elective Modules - Deepening "Imaging and Intervention"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Computed Tomography							5	3	V/Ü				5	3	V/Ü
Methods of MRI				5	3	V/Ü							5	3	V/Ü
Intraoperative Imaging <i>submodule: Medical Imaging in Interventional Endovascular Therapy</i> <i>submodule: Interventional X-Ray Imaging</i> <i>submodule: Angio-lab</i>				5									5		
					1	S								1	S
					1	S								1	S
					2	LP								2	LP
Selected Topics in Image Understanding							5	3	V/Ü				5	3	V/Ü
							10 CP			10 CP			20 CP		

Elective Modules - Deepening "Biomedical Signals"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Digital Information Processing Lab							5	2	S				5	2	S
EMC of Medical Systems							5	3	V/Ü				5	3	V/Ü
Tomographic Imaging in Medicine				5	3	V/Ü							5	3	V/Ü
Functional Safety for Medical and Technical Systems				5	3	V/Ü							5	3	V/Ü
							10 CP			10 CP			20 CP		

Elective Modules - Deepening "Medical Microsystems"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Development of Bio-MEMS for Medical Engineering							10	6	V/Ü/LP				10	6	V/Ü/LP
MEMS-Packaging for Medical Solutions							5	3	V/Ü				5	3	V/Ü
							15 CP			15 CP					

Elective Modules - Deepening "Biomechanics and Haemodynamics"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Simulation and Numerical Methods in Biomechanics and Medical Engineering <i>submodule: Computational Biomechanics</i> <i>submodule: Simulation in Medicine and Medical Engineering</i>				8	4	V/Ü	2						10	4	V/Ü
Rheology and Rheometry							5	3	V/PRO				5	3	V/PRO
Computational Fluid Dynamics							5	3	V/PRO				5	3	V/PRO
				8 CP			12 CP						20 CP		

Elective Modules - Deepening "Medical Computer Science"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Advanced Security Issues in Medical Systems							5	3	S				5	3	S
Bayesian network				5	4	V/Ü							5	4	V/Ü
Image Coding				5	3	V/Ü							5	3	V/Ü
Machine Learning for Medical Systems				5	4	V/S							5	4	V/S
				15 CP			5 CP						20 CP		

Elective Modules - Deepening "Neuro-Biology"	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Theoretical Neuroscience I				5	3	V							5	3	V
Theoretical Neuroscience II							5	3	V				5	3	V
Analysis and modeling of Physiological Systems <i>submodule: Mathematical Modeling of physiological Systems</i> <i>submodule: Analysing Neuronal Network Data from Microelectrode Arrays</i>				4	2	V	1						5	2	V
							1		LP				1		LP
				9 CP			6 CP						15 CP		

Freely selectable Elective Modules	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Selected topics from medical research							5	2	V/S				5	2	V/S
Medical Visualization							6	4	V/Ü				6	4	V/Ü
Computer-aided Diagnosis and Therapy				5	4	V/S							5	4	V/S
Research in Space							5	3	V/Ü				5	3	V/Ü
				5 CP			16 CP						21 CP		

Modules of different faculties selectable on a single-case decision.

Master Thesis

	1. Semester			2. Semester			3. Semester			4. Semester			Summe		
	CP	S	A	CP	S	A	CP	S	A	CP	S	A	CP	S	A
Colloquium for Working-Methods and Intermediate Results										6	4	S	6	4	S
Master Thesis										24			24		
										30 CP			30 CP		