BIOMEDICAL ENGINEERING

Specialized Master's degree program

Joint Degree Master of Science: M Sc in Biomedical Engineering

Biomedical Engineering is a rapidly emerging discipline that applies engineering tools and methods to medical diagnostics and treatment. The students pursuing our program can specialize in a broad range of subdisciplines, including implants and regenerative technologies, image acquisition and therapies, computer assisted surgeries, or on diagnostic and therapeutic technologies. Such interdisciplinary education on medical devices for diagnostic and therapeutic interventions, positions our students in a privileged position develop a career in a thriving academic and industrial environment.

Focal area of teaching and research

This Joint Degree Master in Biomedical Engineering is offered by the School of Life Sciences of the University of Applied Sciences and Arts Northwestern Switzerland (FHNW) and the Medical Faculty of the University of Basel. The program takes place on site at the School of Life Sciences in Muttenz and at the University Campuses in Allschwil and Basel.

The contents of the **first semester** of this program strongly depends on the students' individual background. Thus, students with a medical background undergo a deep dive into basic engineering courses. Inversely, students with an engineering/natural science backgrounds are exposed to the fundamentals of human medicine. In parallel to this tailored education, early fundamentals of biomedical engineering are introduced.

The **second semester** of this program deepens the general biomedical engineering skills and knowledge up to the master's level and sets a focus to one of two study tracks: either Medical System Engineering or Biomaterial Science and Engineering. This is accompanied by a wide range of elective modules of biomedical engineering.

During the **third semester**, the tracks progress towards our specialization foci, including Computer Assisted Surgery, Image Acquisition and Analysis, Diagnostic and Therapeutic Technologies, and Implants and Regenerative Technologies. All specializations are complemented with a wide range of elective courses. The third semester culminates with hands-on training in the form of a semester thesis, lab sessions and practical training. As a result, our students acquire the required skillset to move forward towards the Master's Thesis in the last semester.

Thus, the **fourth semester** is devoted to the Master's Thesis, whereby the students work independently on a scientific project of their choice, supervised by our Professors. The Thesis culminates with a public defense.

Students graduating within this program will obtain a joint degree as «Master of Science in Biomedical Engineering».

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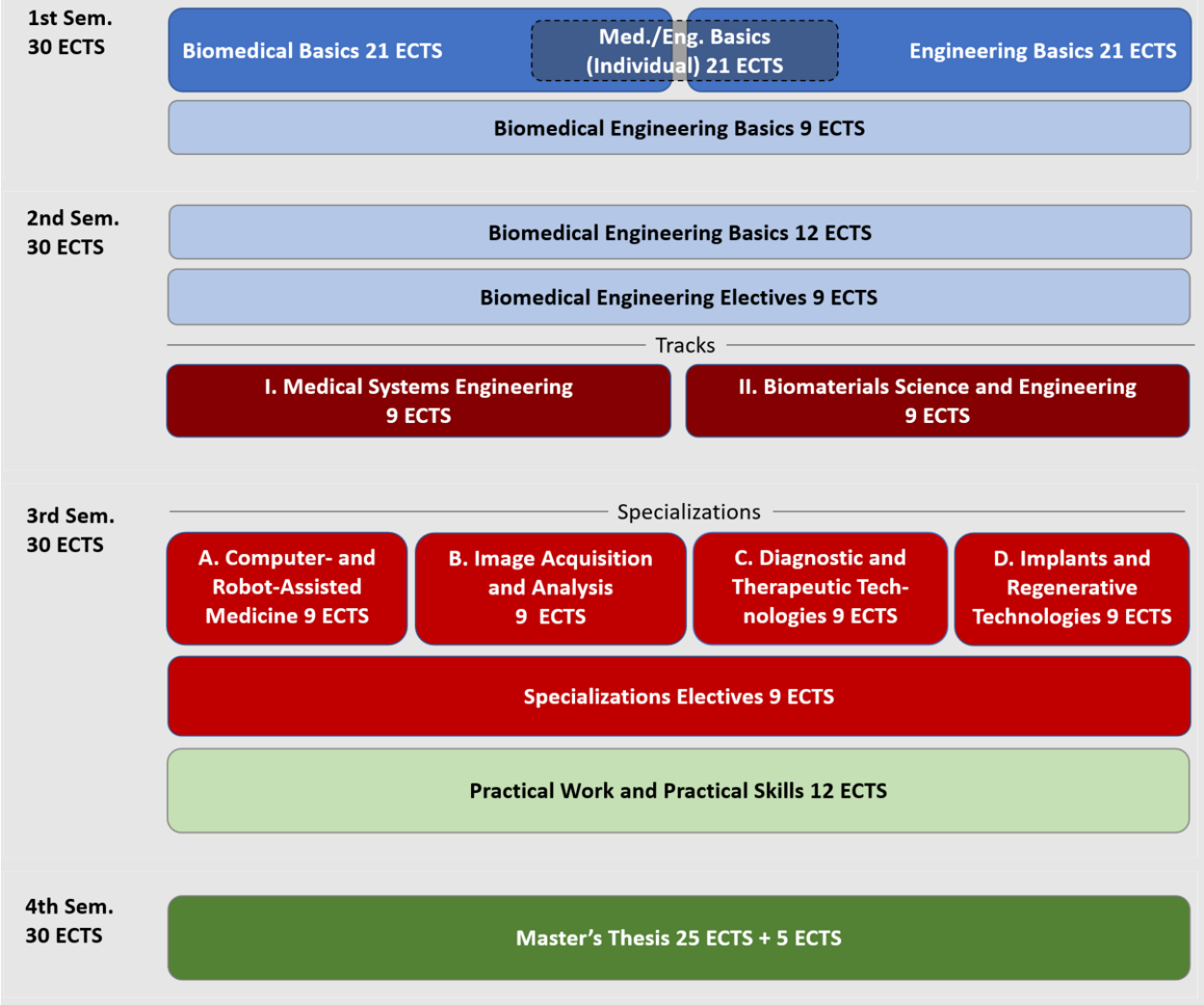

* Not all combinations of modules can be guaranteed

Students can choose during their studies between **two tracks** (2nd Semester) and **four specializations** (3rd Semester):

Track I - Medical System Engineering: This track puts the focus on medical devices using electronics and digitalization, covering topics from the area of signal acquisition and processing, control theory, and includes general aspects of modelling and simulation in biomedical engineering. The track pushes the knowledge toward applications in diagnostics, therapeutics, computer-assisted surgeries, and imaging systems. This track sets the stage for 3rd semester specializations in computer assisted surgery, image acquisition and analysis, or diagnostic and therapeutic technologies.

Track II – Biomaterials Science and Engineering: This track puts the focus on medical devices and technologies involving mechanical or biological materials for diagnostic or therapeutic purposes. The track provides knowledge and skills in material sciences, fabrication technologies in particular with biological materials, all supplemented with relevant aspects in tissue regeneration technologies. This track maps out the 3rd semester specializations in implants, regenerative technology and diagnostic and therapeutic technology.

Specialization A: Computer Assisted Surgery: Students, in the module Computer-Assisted Surgery, gain a comprehensive understanding of the fundamentals to develop new and existing methods for surgeons and medical staff in the complex environment of operating rooms in hospitals such as the principles of

surgical navigation and robotic systems, computer-assisted surgery planning, modelling, simulation and execution by smart tools, robots and visualization systems. Course topics include:

- Computer-assisted surgery
- Medical Robotics
- MR Imaging
- Deep Learning

Specialization B: Image Acquisition and Analysis: This module will discuss advanced imaging techniques like magnetic resonance, ultrasound, X-ray, computer tomography, infrared photography, ...), applied in dental offices, hospitals and forensic institutes. Students will gain insights into the development and application of medical imaging techniques and image analysis and using AI (artificial intelligence) to improve therapy monitoring (ie radiotherapy), for personalized adaptive therapy or for automated approaches in image acquisition and analysis in hospitals or forensics. Courses topics include:

- Digital Dentistry
- Magnetic Resonance Imaging
- Forensic Imaging Methods

Specialization C: Diagnostic and Therapeutic Technologies: This specialization deepens electronic and digital medical devices for specific clinical applications such as neural and deep brain stimulation, brain computer interfaces, hearing diagnostics (audiology), hearing rehabilitation (e.g cochlear implants and hearing aids), and biomechanical tracking systems for functional anatomy and gait analysis. Students learn about diagnostics, bioelectrical and other natural signal sources, digital signal analysis, and therapeutic stimulations. Courses topics include:

- Biomedical Acoustics
- Neurotechnologies
- Clinical Biomechanics

Specialization D: Implants and Regenerative Technologies: This module focuses on the design and manufacturing of medical implants and surgical tools, considering their bulk and surface properties as well as on the characterization of tissues.
It covers the broad range of design, additive and conventional manufacturing and characterization starting at macroscopic scale to reflect the device properties, down to the atomic level, to identify the associations between the nanostructure and function. Regenerative medicine will foster and stimulate interdisciplinary scientific discoveries and the development of advanced therapeutic strategies. Topics include: biomaterial-based control of stem cell function, engineering technologies for tissue and smart implant manufacturing like additive manufacturing and bioprinting, and translational challenges towards industrial exploitation, regulatory requirements and clinical implementation. Courses topics include:

- Regenerative Surgery
- Materials Science and Biomaterials
- Characterizing Materials in Medicine (biocompatibility, micro- and nanostructuring)
- Biointerface Engineering
- Implant Design and Manufacturing

Each specialization is accompanied by a certain number of elective courses, either within the same field of specializations or from any other fields, depending on students individual interests.

Master studies

The Master of Science degree is a postgraduate degree that requires a successfully completed Bachelor's program. The Specialized Master's degree program Biomedical Engineering awards 120 credit points of the European Credit Transfer System (ECTS) and is a so called «mono-course» consisting of only one core subject.

Curriculum master studies with the modules	ECTS
Biomedical Basics or Engineering Basics[1]	21
Biomedical Engineering Basics	21
Biomedical Engineering Electives	9
Medical Systems Engineering *or* Biomaterials Sciences and Engineering	9
Computer- and Robot-Assisted Medicine *or* Image Acquisition and Analysis *or* Diagnostic and Therapeutic Technologies *or* Implants and Regenerative Technologies	9
Electives from Computer Assisted Surgery, Image Acquisition and Analysis, Diagnostic and Therapeutic Technologies, Implants and Regenerative Technologies	9
Project Work and Practical Skills	12
Master's thesis	25
Master's examination	5
Total	120

[1] The respective module allocation will be communicated to each student with their admission. Depending on the bachelor/ background of the student it is also possible that, instead of one module, a selected set of courses of both modules is allocated to the student.

One ECTS credit point corresponds to 30 working hours for an average student.

Course language

The courses are generally taught in English. The Master's thesis is to be written in English.

Exams

Student performance is assessed with a variety of testing methods (e.g. written and oral examinations). The studies are completed by the Master's thesis and a final Master's examination.

Language stays/Internships

No language stays or internships are required.

Combination of subjects

There is no possibility to combine this Master with other Master programs.

Start of program

The program begins in the fall semester.

Duration of study

The full-time Master's program generally takes four semesters, which requires 120 ECTS credit points. There are no restrictions on the duration of study. Part-time enrollment increases the duration of the program accordingly.

Further degrees

A Master of Science in Biomedical Engineering prepares students for a doctorate in Biomedical Engineering but this is not a prerequisite. The doctoral studies last approximately 3-4 years.

Career opportunities

The Master of Science degree in Biomedical Engineering is an excellent preparation for a scientific career (doctoral program) in Biomedical Engineering, for example at the Medical Faculty of the University of Basel, or for other professions in the growing medical technology industry. Graduates are able to support medical experts in a clinical environment and in health care institutions.

Admission

Master studies: To be admitted students must provide evidence of a

a) Bachelor degree of a Swiss University. Evidence of at least 150 credit points from one of the following branches of study must be provided: Medicine, Dentistry, Veterinary Medicine, Human Movement and Sport Sciences, Computer Sciences, Electrical Engineering, Mechanical Engineering, Civil Engineering, Microengineering, Physics, Chemistry, Chemical Engineering, Mathematics, Pharmaceutical Sciences, Computational Sciences, Biology, Materials Science, Biochemistry, Biomedicine/ Biomedical Sciences, Life Sciences and Technologies, Health Sciences and Technology, Forensic Science, Food Sciences, Environmental Engineering and Geomatics Engineering, Environmental Sciences;

or

b) A Bachelor degree of a Swiss University of Applied Science in Systems Engineering, Electrical Engineering, Medical Informatics, Medical Technology, Micro and Medical Technology, Mobile Robotics, Computer Science, Computational and Data Science, Data Science, Digital Life Sciences, Life Sciences, Biotechnology, Chemistry or Photonics, Applied Digital Life Sciences, Aviation, Automotive and Vehicle Engineering, Civil Engineering, Biomedical Laboratory Diagnostics, Digital Engineering, Energy and Environmental Engineering, Industrial Engineering and Management Science, Mechanical Engineering, Mechanical Engineering, Mechatronics Trinational, Optometry, Physiotherapy, Technique en radiologie médicale, Environmental Engineering or Industrial Engineering. A Bachelor degree from a University of Applied Science, either Swiss or foreign, must have a grade average of at least 5 (unrounded) according to the Swiss grading system (1–6, 6 = max. / 4 = pass). For students with a relevant BSc degree but insufficient grade average, the student can alternatively present a GRE test in the area of «Quantitative Reasoning» or «Mathematics» provided the result is in the top 20 % (GRE = Graduate Record Examinations®).

Students with a BSc in a different branch will be assessed individually. Binding information under: www.unibas.ch/admission

Application

Application under http://www.unibas.ch/application; the application fee amounts to CHF 100.-. Application deadline for the fall semester is April 30. Students of the University of Basel see: www.unibas.ch/de/Studium/Im-Studium/Rueckmelden/Masterstudium.html. Application deadline is published there.

Enrollment

The letter of admission also informs students on the procedure of enrollment. In general, students with a Swiss educational background do not have to be present in person for enrollment.

Tuition fees

Tuition fees (also for examination semesters) per semester: CHF 850.-

Individual costs of living etc. are not included. A laptop computer is required for a successful completion of the courses.

Scholarships and student loans: Applications have to be sent to the responsible office of the canton in which the parents are eligible to pay tax. No support is available by the course organizers.

Mobility

Semesters abroad are possible and supported by scholarship programs. The mobility programs facilitate the stay at other Swiss or foreign universities. Further Information: Student Exchange, Petersplatz 1, 4003 Basel, T +41 61 207 30 28, mobility@unibas.ch

Further information

Guidelines and regulations see https://biomedicalengineering.ch/

Information about the University of Basel

- The course directory can be found under: www.unibas.ch/en/Studies/Course-Directory.html
- Basler Studienführer: www.studienberatung.unibas.ch
- Website: www.unibas.ch

Student Advice

Questions regarding the study of Biomedical Engineering can be discussed personally at the Student Administration Office of the Department of Biomedical Engineering (registration via e-mail or phone).

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