University of Basel

Faculty of Medicine

Degree Profile

Specialized Master of Science in Biomedical Engineering

Organizational unit	Department Biomedical Engineering
Degree	MSc in Biomedical Engineering
Range, Duration, Start	90 ECTS, 3 semesters (if full-time), autumn semester
Language of instruction	English

Program Goals

Students develop solid theoretical and applied knowledge of biomedical engineering, including materials science, principles of nanotechnology, characterization of biomaterials, engineering of 3D tissue culture models, medically relevant imaging, medical robotics, medical laser physics as well as signal and image processing.

Program Characteristics

Orientation	Scientific Education
Subject area	Human medicine, Dentistry, Human movement and Sports sciences, Computer science, Electrical engineering, Mechanical engineering, Materials science and engineering, Micro engineering, Physics, Chemistry, Chemical engineering, Mathematics, Pharmaceutical sciences, Computational science and engineering
Majors	–
Program structure	The curriculum consists of the modules: Basics in Human Medicine (15 ECTS) or Mathematics (15 ECTS); Biomedical Engineering (15 ECTS); Biomaterials Science and Nanotechnology or Image-Guided Therapy (28 ECTS); Master thesis (25 ECTS); Master exam (5 ECTS); elective courses (2 ECTS).
Distinctive Features	The program combines natural sciences and medicine in order to advance prevention, diagnosis and treatment of patients. Focus is given on tools for the treatment outcome by conclusive diagnostics, preventing complications, morbidity, and reducing surgery time. The Department of Biomedical Engineering offers an interactive and highly interdisciplinary environment. It is the institutional unit and comprises specialists from the University of Basel, including the University Center for Dental Medicine Basel, the University Hospital Basel and the University Children's Hospital Basel.

Career Opportunities

Employment	Local and international MedTech industry, scientific research, academia, pharmaceutical industry, health care institutions
Further Studies	Doctorate

Teaching

Approaches	Lectures, exercises, practical training, problem-based learning, autonomous learning, research-oriented learning, seminars
Assessments	Written and oral exams, active course participation, master thesis, master exam

Competences

Generic Attitude / Communication Approach / Management	Students acquire the skills to … – carry out independent and creative scientific research. – identify, evaluate and critically analyze scientific literature and understand basic concepts. – work in a team environment. – communicate ideas and results effectively in English language. – actively participate in and lead scientific discussions and deal constructively with criticism. – manage a small research project with respect to both time and content. – organize the scientific work process efficiently, through prior planning and priority setting. – present scientific results and theories concisely in oral and written form to specialist as well as public audiences. – deal responsibly with ethical aspects of the scientific work. – write a concise and well-structured scientific text. – formulate hypotheses and test them through experimentation. – analyze and document experimental data. – plan and conduct scientific experiments in the laboratory. – document and critically interpret scientific results.
Subject related Knowledge / Understanding Application / Judgment Interdisciplinarity	Students acquire the skills to … – understand and apply Nanotechnology for Human Health, Computer-Assisted Surgery, Medical Image Analysis and Magnetic Resonance Imaging as well as Micro- and Nanotomography. – develop and apply medical imaging techniques and image analysis complemented with optical or magnetic stereotactic tracking devices to guide surgeons during surgery. – develop future imaging, image analysis and image-guided therapy solutions in a practical manner for new and improved diagnostic applications/tools. – gain a comprehensive understanding of the fundamentals required to control or manipulate complex imaging techniques, such as magnetic resonance or ultrasound and methods behind the navigation system used during patient treatment. – understand bulk and surface properties of medical implants as well as the characterization of tissues. – characterize human tissue in health and disease using world-leading X-ray-based instrumentation. – use tools to design, fabricate and characterize materials down to the atomic level. – understand relationships between the nanostructure and function. – understand the linkage between interdisciplinary scientific discoveries and the development of advanced therapeutic strategies. – understand biomaterials-based control of stem cell function. – understand engineering technologies for regenerative medicine. – gain insights on translational challenges towards industrial exploitation and clinical implementation. – apply basic statistical concepts and computational methods to analyze biological data. – appreciate the importance of interdisciplinary exchange in scientific research. – design and perform research following high integrity standards.

Learning Outcomes

Graduates of the Specialized Master's Program of Biomedical Engineering ...

– possess the knowledge and skills to plan and conduct a basic or applied research project in the broad area of Biomedical Engineering through the targeted application of adequate methodology for experimental work and data analysis and are able to present their results and conclusions clearly to peers and the public in written and oral form.
– know state-of-the-art research and experimental methods and can use this knowledge to concisely formulate, analyze and test relevant research questions and hypotheses.

- are able to correctly describe the technical details of experimental methods and adapt them appropriately to relevant research questions and systems in order to provide scientifically-grounded positive and negative arguments for a given experimental research approach in the discipline of specialization.
- possess scientific knowledge of the fundamental background underlying Biomedical Engineering, in particular in the areas of Image-Guided Therapy and Biomaterials Science and Nanotechnology, and are able to appropriately apply this knowledge to use and develop state-of-the art instrumentation and techniques to assist the clinical practice.
- are able to independently carry out a complete research project in the field of Biomedical Engineering, including literature searches, the framing of research questions in the context of current research of the field, conduct appropriate experimental work and laboratory practices, and can clearly and concisely present their results to peers as well as to the public in written and oral form according to scientific standards.
- are able to appropriately apply computational methods to interpret complex multivariable datasets and present properly the conclusions of the analysis.
- understand the ethical aspects and considerations linked to their research involving human subjects and can distinctly argue for the appropriate and responsible use and the scientific necessity of the applied methods.