University of Basel

Faculty of Medicine

Degree Profile

Specialized Joint Degree Master Biomedical Engineering

Organizational unit	Department of Biomedical Engineering FHNW University of Applied Sciences Northwestern Switzerland, School of Life Sciences
Degree	MSc in Biomedical Engineering
Scope, Duration, Start	120 ECTS, 4 semesters (if full-time), autumn semester
Language of instruction	English

Program Goals

Students develop solid theoretical and applied knowledge of biomedical engineering, including state-of-the-art medical image acquisition and image analysis, a broad range of current and novel diagnostic and therapeutic technologies, innovative medical robotics and visualization systems for surgery as well as additive and conventional generation and characterization of implants and regenerative technologies.

Program Characteristics

Orientation	Scientific Education
Majors	–
Program structure	The curriculum consists of the modules: Biomedical Basics and/or Engineering Basics (21 ECTS); Biomedical Engineering Basics (21 ECTS); Biomedical Engineering Electives (9 ECTS); Biomedical Systems Engineering or Biomaterials Science and Engineering (9 ECTS); Computer and Robot Assisted Medicine; Image Acquisition and Analysis; Diagnostic and Therapeutic Technologies; Implants and Regenerative Technologies (at least 9 ECTS within one single module, in total 18 ECTS); Project Work and Practical Skills (12 ECTS); Master's Thesis (25 ECTS); Master's Examination (5 ECTS)
Distinctive Features	The program combines natural sciences, medicine and engineering in order to advance disease prevention, diagnosis, and treatment of patients. The focus is on improving treatment outcomes through reliable diagnostics, avoiding complications, shortening surgical treatment times as well as reducing mortality. The program is a joint Degree offered by the University of Basel (Department of Biomedical Engineering) and the FHNW School of Life Sciences (Institute for Medical Engineering and Medical Informatics). 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, the University Children's Hospital Basel and the Institute of Forensic Medicine. At the Institute for Medical Engineering Technology and Medical Informatics (FHNW) professionals from diverse fields conduct research and participate in teaching activities, including Bachelor's, Master's and continuing education programs.

Career Opportunities

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

Teaching

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

Competences

Generic Attitude / Communication Approach / Management	Students acquire the skills to … - carry out independent and creative scientific and applied 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. - understand the linkage between interdisciplinary scientific discoveries and the development of advanced therapeutic strategies. - gain insights on translational challenges towards industrial exploitation and clinical implementation.
Subject related Knowledge / Understanding Application / Judgment Interdisciplinarity	Students acquire the skills to … - develop future imaging, image analysis and image-guided therapy solutions in a practical manner for new and improved diagnostic and therapeutic tools. - develop and design medical systems containing diagnostics sensors, embedded systems, and involving advanced and model-based signal processing techniques. - understand bulk and surface properties of medical implants and the characterization of tissues, and translate their application in implant design. - use tools to design, fabricate and characterize materials down to the atomic level. - apply basic statistical concepts and computational methods to analyze biological data. - understand the generation, propagation, monitoring, and analysis of neural signals, including neurostimulation as a diagnostic and therapeutic tool. - understand the drug development process with its process specific requirements, and the common drug delivery systems. - take advantage of modelling and simulation in a development process. - gain comprehensive knowledge of robotics in a clinical setting (surgical robots, robotic prosthetics/orthoses, assistive devices, rehabilitation training devices, medical simulators). - use computers as aid in planning and executing surgeries. - understand engineering technologies for regenerative medicine. - understand the legal framework and requirements for development of Medical Devices in Europe.

Learning Outcomes

Graduates of the Specialized Joint Degree Master's Program in Biomedical Engineering ...

- possess 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, 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 and development activities involving human subjects and can distinctly argue for the appropriate and responsible use and the scientific necessity of the applied methods.
- have basic knowledge of the regulatory and legal framework in their field of research activity and are thus able to effectively transfer their scientific discoveries and inventions into medical applications and medical products for the MedTech market.