

## ***MSc in Biomedical Engineering (Cycle 2, level 4)***

The objective of biomedical engineering is to apply the methods of engineering discipline to understand, modify, or control biological systems and thus improve the quality of life.

Biomedical Engineering MSc is a 2 year full-time graduate study program of 120 ECTS credits (4 semesters, 30 ECTS each semester).

All students are required to complete a set of four core courses, equivalent of about one semester (a total of 28 ECTS). Students can either take 90 ECTS in specialized courses and a 30 ECTS MSc thesis, or 60 ECTS in courses and a 60 ECTS MSc thesis with a stronger research focus.

Admission requirement is a BSc degree in engineering. Minimum requirements in applied sciences (i.e. mathematics, physics, and biosciences) and in basic subjects fundamental to Biomedical Engineering (i.e. physiology, biosignals and clinical applications, or other core topics in biomedical engineering,) have to be fulfilled. Students admitted to the MS-program that do not fulfill these minimum requirements are required to take appropriate fundamental courses in biomedical engineering.

After successful completion of the programme the student is awarded the degree Master of Science in Biomedical Engineering. The degree Master of Science in Biomedical Engineering provides education equivalent to the requirements for the professional title of Chartered Engineer (Icelandic: verkfræðingur), as defined by the Ministry of Industry and the Association of Chartered Engineers in Iceland. The degree also complies with the curriculum recommended by the International Federation for Medical and Biological Engineering for the accreditation of biomedical engineering programs in Europe (based on the European workgroup BIOMEDEA).

On the completion of the MSc program in addition to relevant undergraduate studies, the following criteria shall be fulfilled, in addition to the criteria fulfilled at former levels. For further information, i.e. learning outcomes for each course, see the Course Catalog [www.ru.is](http://www.ru.is)

### **KNOWLEDGE AND UNDERSTANDING**

On completion of the MSc program, the student shall possess a systematic generalized understanding and knowledge of the following topics:

- An advanced knowledge of a broad range of modelling methodologies, and underlying biomedical science, commonly used in the development and analysis of biomedical engineering systems.
- Knowledge of fundamental design issues relevant to biomedical engineering, and an understanding of how to formulate and analyse design solutions in various engineering and medical contexts.
- Working knowledge of a range of modern mathematical methods and tools used in the development and analysis of biomedical systems.
- Understanding and knowledge of basic research and development principles and practices relevant to mainstream engineering industry and in clinical applications.
- Knowledge of key professional, safety and ethical issues arising in the medical environment and in modern engineering industry.

- Knowledge of time-management and work planning issues related to the organization, implementation and successful completion and reporting of an individual Masters level research project.
- Research methodology, including the fundamentals of scientific writing, literature search, how to give a scientific presentation, how to evaluate a scientific paper, and research ethics.

### **TYPE OF KNOWLEDGE**

On completion of the MSc program, the student shall possess specific knowledge and understanding in all of the following topics, most of which the student will have acquired in previous studies and some of which the student will acquire in the MSc program:

- General knowledge in all the following subjects:
  - Mathematics: Calculus in one and more dimensions, linear algebra and geometry, ordinary differential equations, numerical analysis.
  - Physical subjects: mechanics, dynamics, statics, electromagnetics, circuit theory and electronics, materials science, chemical sciences, thermodynamics, heat transfer and fluid mechanics.
  - Bio- and medical sciences: molecular and cell biology, physiology, biosignals, medical imaging, clinical engineering and biomedical technology as applied in both diagnosis and treatment in the medical environment
  - Technology: programming, numerical modelling, project management and control theory.
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On completion of the MSc program, the student shall also possess:

- In-depth knowledge in at least one specific field of biomedical engineering depending on selected specialization courses and final project.
- State-of-the-art knowledge in the chosen research area.

### **PRACTICAL SKILLS**

On completing the programme students should be able to:

- Propose, plan and manage well defined research and design projects involving a team of individuals. Prioritise, organise and schedule work activities effectively. Work effectively in a team of individuals.
- Interpret and critically assess existing theories, models, methods and results, both qualitatively and quantitatively, within a broad engineering, physical and medical science framework.
- Recognize and appreciate problems inherent in a given engineering system or approach, and be able to synthesise, and propose evaluation methods or develop alternative solution strategies.
- Have the ability to assess engineering projects, identify the key factors in a given situation, and develop an approach to a solution.
- Work in a team of professionals from different fields on complex project, contributing to the analysis of the project and to its solutions, participate in the evaluation of different solutions and be active in the implementation of the best practical solution.
- Analyze complex real-world problems and devise efficient and well-documented computer-based solutions for those. Use mathematical

models and their associated analysis techniques in the design and evaluation of solutions for problems.

- Work with technical uncertainty.
- Apply engineering techniques taking account of a range of commercial, medical, ethical and industrial constraints.
- Appreciate the meaning and importance of professionalism, including integrity and adherence to independent informed judgement.

### **THEORETICAL SKILLS**

On completion of the MSc program, the students shall have sufficient, comprehensive understanding to be able to:

- Assimilate and integrate their knowledge, make assessments and utilize their knowledge and understanding in solving relevant problems in engineering and in biomedical engineering in particular.
- Identify, adapt and develop models appropriate to the study of a wide-range of different biomedical engineering type systems, processes and products.
- Apply standard scientific principles to develop engineering solutions to a range of practical problems.

### **COMMUNICATION SKILLS AND INFORMATION LITERACY**

On completion of the MSc program, the student should be able to:

- Propose, plan and manage well defined research and design projects involving a team of individuals. Prioritise, organise and schedule work activities effectively. Work effectively in a team of individuals.
- Communicate effectively and professionally and formulate sound arguments both in writing and by means of presentations using appropriate technical language.
- Find information that is relevant to research using search engines, on line libraries and repositories. Effectively utilize modern information resources and technologies.
- Analyze and communicate statistical data.
- Report on their work, and that of others, both to a specialist and a general audience.
- Discuss ethical issues in research work with their peers in an informed and reasoned fashion.

### **LEARNING SKILLS**

On completion of the MSc program, the student should be able to:

- Ask new questions based on available information and knowledge and use known facts to create new ones.
- Make creative use of known information, methods, concepts and theories in new situations.
- Generalize from a collection of specific instances.
- Infer possible causes from the available data, discovering patterns in the available information.
- Interpret facts by comparing them and contrasting them with one another, drawing conclusions and predicting possible outcomes.

- Make choices based on reasoned arguments, and evaluate the outcomes of those choices by comparing them with alternative solutions.
- Appreciate the importance of continuing education and lifelong learning and undertake the study required to maintain and expand professional competence and keep up with evolving technology.
- Continue studies within this field towards an advanced degree i.e. at PhD level, having developed the necessary personal autonomy and knowledge to do so.