MSc in Biomedical Engineering

The programme leading to an MSc degree in Biomedical Engineering is 300 ECTS credits, a 5 year full-time study programme which can be divided into a 180 ECTS BSc degree programme at undergraduate level, and a 120 ECTS MSc degree programme at graduate level. The degree Master of Science in Biomedical Engineering provides education designed to fulfil 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 programme draws on natural science, engineering, biology and medicine to create a knowledge-base that equips students to deal with a range of problems and challenges in biomedicine, characterized by increasing interdisciplinary and international activities. The student must be able to combine broad knowledge with a deep understanding of the core discipline of biomedical engineering. In addition to general principles, theories and applications the student will have in depth knowledge in at least one specific field of biomedical engineering, depending on specialisation courses and final project.

Upon completion of both the BSc programme and the MSc programme, a total of 300 ECTS credits, the following criteria shall be fulfilled:

1. KNOWLEDGE Upon completion of both the BSc and the MSc programme, a total of 300 ECTS credits, the student should possess knowledge and understanding of the following:	
	1.1. Mathematical analysis common to most engineering disciplines, multivariable calculus, including differentiation and integrals, and differential equations. 1.2. Principles of linear algebra, vectors, matrices, determinants, eigenvalues and eigenvectors, and of solving systems of linear equations. 1.3. Complex numbers and exponentials, Laplace and Fourier transforms. 1.4. Numerical methods to solve problems in calculus, differential equations and linear algebra.

	1.5. Basic probability theory and statistics including data analysis, error analysis, hypothesis testing and linear regression. 1.6. Calculus based physics common to most engineering disciplines, including a practical foundation in classical dynamics, electromagnetism, thermodynamics and fluids dynamics. 1.7. Main areas of applied chemistry, including atomic structure, phases of matter, reactions and equilibrium, and introduction to bio- and organic chemistry. 1.8. Basic understanding of engineering programming in common languages, such as Matlab and C++, and spreadsheet applications. 1.9. Basic project management methods, how projects arise and the different stages in the life-cycle of a project. 1.10. Basic understanding of innovation and entrepreneurship, techniques of idea generation, launching a new company and business plans. 1.11. Structural mechanics, stress theory, safety of structures, and basic use of computational tools in design, including 3D CAD. 1.12. Analysis and design of electric circuits, electronics and digital electronics. 1.13. Fundamentals of control theory. 1.14. Theory and application of signal processing concepts, methods and algorithms. 1.15. Electrical measuring techniques. 1.16. Properties, structure and application of selected material groups 1.17. Modern physics, including photons, radiation and relativity, and basic principles of geometric optics. 1.18. Fundamentals of molecular- and cell biology, physiology, and the function of physiological systems. 1.19. Medical technology, technical challenges and use in clinical environment.

SKILLS

Upon completion of both the BSc programme and the MSc programme, a total of 300 ECTS credits, the student should possess skills to be able to:

2. Disciplinary skills

2.1. Design, and to some extent implement biomedical engineering devices.

2.2. Carry out measurements of bio signals and describe the underlying mechanisms and processes, including EEG, EMG and ECG.

2.3. Describe the underlying physical process of the main modalities of medical imaging, describe some applications, describe and apply basic image processing.

2.4. Design lab experiments, collect and analyse data from physical and simulated test systems and use the results to solve technical problems.

2.5. Apply project management methods to the planning of projects.

2.6. Apply methods from mathematics and physics to analyse and model simple biomedical engineering systems, including processes and medical devices.

2.7. Solve biomedical engineering problems including those involving the interaction between tissue and devices, including mechanical, electrical and biological.

2.8. Describe the underlying principles and applications of common medical devices.

2.9. Actively participate in applying biomedical technology in both diagnosis and treatment in the medical environment, for example functional electrical stimulation and radiation therapy.

2.10. Comprehend and plan health and safety procedures, including electrical safety in the clinical environment and ionizing radiation protection.

2.11. Outline the management of medical technology and design of clinical environment.

2.12. Describe and be able to use medical informatics systems.

2.13. Describe the structure and main aspects of the healthcare system in Iceland.

2.14. Find and be aware of the need to follow the relevant standards in biomedical engineering.

2.15 Read and comprehend scientific papers within the field of biomedical engineering.

3. Personal skills	3.1. Apply engineering methods to complex projects, i.e. have the ability to assess engineering projects, identify the key factors in a given situation, and develop an approach to solution. 3.2. Formulate and work on open-ended problems, including creative thinking. 3.3. Apply research methodology, including the fundamentals of technical writing and information finding, including literature search. 3.4. Realize the limits of his/her expertise and know when it is necessary and appropriate to seek specialist advice. 3.5. Apply standard scientific principles to develop engineering solutions to a range of practical problems. 3.6. Apply research methodology and critical thinking, including the fundamentals of scientific writing, literature search, evaluate a scientific paper, and be aware of research ethics. 3.7. Identify and appreciate key professional and ethical issues in engineering including the social responsibility of engineering practice. 3.8. Appreciate the importance of ethics in medicine, respect patient dignity and confidentiality of medical data. 3.9. Be able to communicate in medical terms with healthcare personnel.

4. Interpersonal skills	4.1. Read and write in English, and in Icelandic if a native student. 4.2. Communicate effectively and professionally and formulate sound arguments, both in writing and by means of presentations, using appropriate professional language, including statistics, figures, illustrations, equations, tables and video. 4.3. Use time management and work planning related to the organization, implementation and successful completion and reporting of a project. 4.4. Be an effective team member and contribute to the management of team projects. 4.5. Recognize the interdisciplinary nature of technical problems and work with other professions to arrive at a solution for complex engineering problems. 4.6. Give an oral scientific presentation and write a research report, and be able to communicate in English. 4.7. Propose, plan, structure and manage well defined projects involving a team of individuals from different professional disciplines. Prioritize, organize and schedule work activities effectively. 4.8. Work with and recognize the importance of involving a range of different stakeholders and interests. 4.9. Discuss ethical issues in research work with their peers in an informed and reasoned fashion and apply an ethical approach to all work.

5. COMPETENCE

Upon completion of both the BSc programme and the MSc programme, a total of 300 ECTS credits, the student should be able to utilize the knowledge and skills he/she has acquired to:

5.1. Apply analytical skills and modelling methodologies to recognize, analyse, synthesize and implement operational solutions to engineering problems.

5.2. Apply standard scientific principles to develop engineering solutions to a range of practical problems.

5.3. Appreciate the importance of keeping up with evolving technologies and research, and of lifelong learning to maintain and expand professional competence.

5.4. Use design standards and safety codes as an integral part of the design and the implementation process.

5.5. Design conceptional solutions to diffuse problems i.e. clarify the financial, technical, social and managerial approaches to the problem.

5.6. Adapt quickly to new problems and challenges arising in the context of engineering.

5.7. Apply professional judgment and recognized conventions that are relevant to problem solving.

5.8. Interpret and apply existing theories, models, methods and results, both qualitatively and quantitatively, within the field of engineering.

5.9. Participate in product development and research within the broad field of engineering, recognizing their roles in the innovation process.