## *BSc in Mechanical Engineering*

The programme leading to a BSc degree in Mechanical Engineering is 180 ECTS credits. Students take 84 ECTS credits in fundamental courses that are the same for all three-year BSc engineering programmes, 66 ECTS credits in courses that are specific to their chosen discipline (Mechanical Engineering) and 30 ECTS credits in elective courses. The main aim of the programme is to prepare students for studies in engineering at the MSc level.

The programme in mechanical engineering draws on the principles of engineering, and the physical sciences to create a broad knowledge base that equips students to deal with a range problems and challenges including the design, analysis, operation and maintenance of mechanical systems. The student must have a firm understanding of the core concepts of mechanical engineering including mechanics, kinematics, thermodynamics, materials science, structural analysis, computation, and electricity, and be able to apply these to the design and analysis of diverse industrial and civil equipment, manufacturing plants, machinery, heating and cooling systems and transport systems.

Upon completion of the BSc programme, the following criteria shall be fulfilled:

**1. KNOWLEDGE**

Upon completion of the BSc programme the student should possess knowledge and understanding of the following:

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| | 1.1. Mathematical analysis common to most engineering disciplines, multivariable calculus, including differentiation and integrals, 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, fluid dynamics. |
| | 1.7. Main areas of applied chemistry, including 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. Main areas of material science and manufacturing processes. |
| | 1.12. Structural analysis and strength of materials, idealization of complex structures, differential analysis of simple structures and applications of Finite Element Methods to complex structure, safety of structures. |
| | 1.13. Properties of fluids and application of the basic laws of fluid dynamics in a control volume as well as in differential form to practical engineering problems. Analysis of simple incompressible flows. |

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| | 1.14. Thermodynamics and its applications, laws of thermodynamics, properties of substances and phase changes, application to common thermodynamic cycles and components.<br>1.15. Fundamentals of heat transfer, including radiative heat transfer, conduction and various forms of convection heat transfer with focus on common engineering applications.<br>1.16. Dynamical systems, system identification and control engineering.<br>1.17. Properties of electric circuits.<br>1.18. Properties of common machine elements, with emphasise on fatigue, lifetime and reliability. Machine design using computer-aided design software. |
| **SKILLS**<br>Upon completion of the programme, the student should have gained the skills to: | |
| **2. Disciplinary skills** | 2.1. Apply methods from physics, mechanics and materials science to model systems in mechanical and energy engineering.<br>2.2. Use mathematical methods and tools in the analysis and development of mechanical engineering systems.<br>2.3. Plan, manage and analyse projects, using current best-practice methods.<br>2.4. Devise lab experiments, collect and analyse data from physical and simulated test systems and use the results to solve technical problems.<br>2.5. Design machine elements and machine systems or processes to meet or exceed a set of performance specifications, standards and codes.<br>2.6. Use lab equipment effectively and safely to analyse material and mechanical properties of machine elements and machines.<br>2.7. Use computational tools and packages in mechanical design, process design and planning, including 3D CAD and FEM software.<br>2.8. Analyse and communicate experimental, numerical and statistical data.<br>2.9. Planning and supervision of industrial processes.<br>2.10. Dynamical systems, system identification and control engineering.<br>2.11. Apply project management methods to the planning of projects and apply business administration methods to industrial enterprises.<br>2.12. Carry out risk assessment as an integral part of the design process. |

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| **3. Personal skills** | 3.1. | Apply engineering methods to projects, i.e. have the ability to assess engineering projects, identify the key factors in a given situation, and develop an approach to a 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. | Apply standard scientific principles to develop engineering solutions to a range of practical problems.<br>Realise the limits of his/her expertise and know when it is necessary and appropriate to seek specialist advice. |
| **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. |

**5. COMPETENCE**

Upon completion of the BSc programme, the student should be able to utilise the knowledge and skills he/she has acquired to:

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| | 5.1. | Apply analytical skills and modelling methodologies to recognise, analyse, synthesise 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. | Undertake further studies towards a graduate level degree. |