Learning outcomes for BSc in Mechanical and Energy Engineering

**BSc in Mechanical and Energy Engineering**

The Mechanical and Energy Engineering BSc program is 3.5 years (7 semesters) full time study. The total credits are 210 ECTS. Students have the option of choosing between two fields of specialization: Mechanical Design or Energy Technology. A student who chooses at least 3 courses in the 6th semester, as well as his final project in the 7th semester, in the same field gets a certificate of graduation in which his field of specialization is especially noted.

The program covers the basics of mathematics, physics, computer science, statics, dynamics, continuum mechanics, thermodynamics, hydraulics and materials science. The students are provided with knowledge and skills in selected areas of mechanical design, energy technology and management, based on their knowledge and understanding of the principles of the above listed subjects. Emphasis is placed on projects in order to expose the students to real world problems related to mechanical and energy engineering.

The aim of the program is to provide industry with capable mechanical engineers for careers in industry, with a well defined and strong skill set as is internationally expected of mechanical engineers.

On the completion of the BSc program, the following criteria shall be fulfilled:

1. **KNOWLEDGE**

On completion of the BSc program the student should possess understanding and knowledge of the following:

1.1. Basic principles of multivariable calculus, including differentiation, integration and differential equations.
1.2. Laplace and Fourier transform, complex exponentials and applying them to solve differential equations.
1.3. Basic principles of linear algebra, vectors, matrices, determinants, eigenvalues, eigenvectors and solving systems linear equations.
1.4. Probability and statistics, data analysis and error estimates.
1.5. Numerical methods relevant to engineering.
1.6. Physics common to most engineering disciplines, including a practical foundation in classical dynamics, electromagnetism, fluid mechanics and thermodynamics.
1.7. Basic principles of engineering programming using Matlab and spreadsheet applications.
1.8. Main areas of material science and manufacturing processes.
1.9. Structural analysis and the safety of structures.
1.10. Fundamentals of fluid statics and fluid flow.
1.11. Design of machine elements and machine design using computer-aided design software.
2. DISCIPLINARY SKILLS

On completion of the BSc program the student should be able to:

2.1. Apply methods from physics, mechanics and materials science to model systems in mechanical and energy engineering.
2.2. Extract relevant physical properties from the Laplace transforms of differential equations.
2.3. Devise lab experiments, collect and analyse data from physical and simulated test systems and use the results to solve technical problems.
2.4. Design machine elements and machine systems or processes to meet or exceed a set of performance specifications, standards and codes.
2.5. Use lab equipment effectively and safely to analyse material and mechanical properties of machine elements and machines.
2.6. Carry out risk assessment as an integral part of the design process.
2.7. Use computational tools and packages in mechanical design, process design and planning, including 3D CAD and FEM software.
2.8. Use common machine shop tools safely to build and test prototypes of own design.
2.9. Solve common, technical problems in the design of smaller machine elements and machines and analysis of energy processes and be able to seek specialist advice as needed for more complicated problems.
2.10. Identify the process of innovation and the main factors of entrepreneurship and creative thinking and apply methods of product development.
2.11. Plan and supervise industrial processes.
2.12. Analyse fluid and energy systems with respect to fundamental principles.
2.13. Apply project management methods to the planning of projects. Plan, manage and analyse projects, using current best-practice methods.
2.15. Design basic pipe and HVAC (heating, ventilating, and air conditioning) systems.
2.16. Set up, monitor and maintain machine parts and machine systems.

3. PERSONAL SKILLS
On completion of the BSc program, the student should be able to:

3.1. Communicate in English and Icelandic (written and spoken) effectively and professionally, and be able to present results using appropriate technical language and presentation tools i.e. graphs, illustrations and simulations.
3.2. Utilize time-management and work-planning related to the organization, implementation and successful completion and reporting of a project.
3.3. Find information that is relevant to engineering as well as research and development work and effectively utilize modern information resources and technologies.
3.4. Make choices based on reasoned arguments, and evaluate the outcomes of those choices by comparing them with alternative solutions.
3.5. Work in and lead a multidisciplinary project group, where it is necessary to formulate and solve open problems.
3.6. Undertake continuing education for his/her professional development or further education i.e. at graduate level.

4. INTERPERSONAL SKILLS

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

4.1. Communicate effectively and professionally and formulate sound arguments, both in writing and by means of presentations, using appropriate scientific and technical language.
4.2. Present ideas in an organized manner, and deliver presentations to peers and advisors from the industry using the latest presentation tools.
4.3. Propose, plan, structure and manage well defined projects involving a team of individuals. Prioritise, organise and schedule work activities effectively.
4.4. Recognize the interdisciplinary nature of technical problems, apply other areas of knowledge to the solution, and work with other professionals to arrive at a solution to complex engineering problems.
4.5. Give an oral scientific presentation, report on a research or design project, and execute a research or design report.
4.6. Participate as a member of a team and contribute to the management of team projects.
5. COMPETENCE

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

5.1. Solve specific technical problems covering all phases of CDIO (Conceive, Design, Implement, Operate) from problem identification, idea generation and requirements specification, through design, optimization and implementation to actual production and commissioning.

5.2. Define and structure complex, real-world problems in order to analyse and develop relevant solutions.

5.3. Analyse a problem specification, compare alternative designs, processes, and products and make improvements.

5.4. Evaluate existing designs/processes/products and propose improved realizations.

5.5. Use design standards and safety codes as an integral part of the design and building process for machine parts and systems.