Learning outcomes for MSc in Mechanical Engineering

MSc in Mechanical Engineering

The program leading to an MSc degree in Mechanical Engineering is a 5 year full time graduate study program of 300 ECTS credits (10 semesters, 30 ECTS each semester), which can be divided into a 180 ECTS BSc degree and a 120 ECTS MSc degree. Students will receive the MSc degree in Mechanical Engineering upon completion of the program. The degree Master of Science in Biomedical Engineering provides education fulfilling 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.

Mechanical Engineering

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

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

1. KNOWLEDGE

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

1.1. Mathematical analysis common to most engineering disciplines, multivariable calculus, including differentiation and integrals, differential equations

1.2. Complex numbers and exponentials, Laplace and Fourier transforms.

1.3. Principles of linear algebra, vectors, matrices, determinants, eigenvalues and eigenvectors, and of solving systems of linear equations.

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

1.14. Thermodynamics and its applications, laws of thermodynamics, properties of substances and phase changes, application to common thermodynamic cycles and components.

1.15. Fundamentals of heat transfer, including radiative heat transfer, conduction and various forms of convection heat transfer with focus on common engineering applications.

1.16. Dynamical systems, system identification and control engineering.

1.17. Properties of electric circuits.

1.18. Properties of common machine elements, with emphasize on fatigue, lifetime and reliability. Machine design using computer-aided design software.

2. DISCIPLINARY SKILLS

On completion of the MSc 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. Use mathematical methods and tools in the analysis and development of mechanical engineering systems.

2.3. Plan, manage and analyse projects, using current best-practice methods.

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

2.5. Design machine elements and machine systems or processes to meet or exceed a set of performance specifications, standards and codes.

2.6. Use lab equipment effectively and safely to analyse material and mechanical properties of machine elements and machines.

2.7. Use computational tools and packages in mechanical design, process design and planning, including 3D CAD and FEM software.

2.8. Analyse and communicate experimental, numerical and statistical data.

2.9. Planning and supervision of industrial processes.

2.10. Dynamical systems, system identification and control engineering.

2.11. Apply project management methods to the planning of projects and apply business administration methods to the running of industrial enterprises.

2.12. Carry out risk assessment as an integral part of the design process

2.13. Analyse and design fluid and energy systems with respect to fundamental principles.

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

3. PERSONAL SKILLS

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

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. Apply research methodology and critical thinking, including the fundamentals of scientific writing, literature search, evaluate a scientific paper, and be aware of research ethics.

3.5. Identify and appreciate key professional and ethical issues in engineering including the social responsibility of engineering practice.

4. INTERPERSONAL SKILLS

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

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. Give an oral scientific presentation and write a research report, and be able to communicate in English.

4.6. Propose, plan, structure and manage well defined projects involving a team of individuals from different professional disciplines. Prioritize, organize and schedule work activities effectively.

4.7. Recognize the interdisciplinary nature of technical problems and work with other professions to arrive at a solution for complex engineering problems.

4.8. Work with and recognize the importance of involving a range of different stakeholders and interests.

5. COMPETENCE

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

5.1. Apply analytical skills and modelling methodologies to recognize, analyze, 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 conceptual 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

5.10. Undertake further studies towards a graduate level degree.