BSc in Energy Engineering

The program leading to a BSc degree in Energy Engineering is a 3 year full time undergraduate study program of 180 ECTS credits (6 semesters, 30 ECTS each semester); cycle 1.2. Students will receive the BSc degree in Energy Engineering upon completion of the program.

Students take 84 ECTS credits in fundamental courses that are the same for all three-year BSc engineering programs, 60 ECTS credits in courses that are specific to their chosen discipline (Energy Engineering), a 12 ECTS capstone project course and 24 ECTS credits in elective courses. The main aim of the program is to prepare students for studies in engineering at the MSc level.

The program in energy 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 in energy engineering, including the design, analysis, operation and maintenance of energy systems.

Students must have a firm understanding of the core concepts including statics & mechanics, dynamics, materials science, thermodynamics, fluid mechanics and heat transfer, sustainability, electricity and power generation, and be able to apply these to the design and analysis of diverse energy and industrial and systems, power plants, heating and cooling systems and transport systems.

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. In the basic principles of multivariable calculus, including differentiation, integration and differential equations.

1.2. Basic principles of linear algebra, vectors, matrices, determinants, eigenvalues, eigenvectors and solving systems linear equations.

1.3. Complex numbers, complex exponentials, Laplace and Fourier transform and their applications in solving dynamical systems.

1.4. Basic probability and statistics, data analysis and error estimates.

1.5. Basic numerical methods relevant to engineering.

1.6. Physics, common to most engineering disciplines, including a practical foundation in classical dynamics, electromagnetism, and solid-state materials.

1.7. Main areas of applied chemistry, including phases og matter, reactions and equilibrium, and introduction to bio- and organic chemistry.

1.8. Basic understanding of engineering programming in common languages, such as Python, Matlab and C++, and spreadsheet applications.

1.9. Main areas of material science and manufacturing processes.

1.10 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.

1.11 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.

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

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

1.14 Dynamical systems, system identification and control engineering.

1.15 Properties of electric circuits, circuit theorems, passive components, operational amplifiers, time response of RC, RL and RCL circuits, phasor and steady state analysis.

1.16 Fundamentals of instrumentation and measurement, applications and limitations of measurement systems, data acquisition and handling, common sensor technologies, treatment of uncertainty and error analysis.

1.17 Synchronous and asynchronous generators and motors; power low through impedances; single phase, linear induction and stepper motors.

1.18 Basic project management methods, how projects arise and the different stages in the life-cycle of a project.

1.19 Basic understanding of innovation and entrepreneurship, techniques of idea generation, launching a new company and business plans.

1.20 Sustainability, environmental impact and life cycle assessment of energy engineering works.

2. DISCIPLINARY SKILLS

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

2.1. Apply methods from physics, mechanics, materials science, mathematics and computer science to model systems in energy engineering.

2.2. Use mathematical methods and tools in the analysis and development of energy 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 energy 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 properties of power elements and systems.

2.7. Use computational tools and packages in component design, process design and planning.

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

2.9. Plan and supervise industrial processes.

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

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

3. PERSONAL SKILLS

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

3.1. Communicate effectively and professionally and be able to present results using graphs, illustrations and simulations.

3.2. Use time-management and work planning related to the organization, implementation and successful completion and reporting of a project.

3.3. Interpret and critically assess existing theories, models, methods and results, both qualitatively and quantitatively, within a broad engineering and physical sciences framework.

3.4. Make choices based on reasoned arguments, and evaluate the outcomes of those choices by comparing them with alternative solutions.

3.6. Realize the limits of his/hers expertise and know when it is necessary and appropriate to seek specialist advice.

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.

4.3. Be an effective team member 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 the 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. Use design standards and safety codes as an integral part of the design and building process for energy and power systems.

5.3. Appreciate the meaning and importance of professionalism, including ethics, integrity and adherence to independent, informed judgement.

5.4. Continue studies within this field towards an advanced degree, i.e. at MSc level, having developed the necessary personal autonomy and knowledge to do so.