MJ2419 Energy Storage Systems 4.0 credits

Energilagringssystem

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for MJ2419 valid from Spring 2020

Grading scale

A, B, C, D, E, FX, F

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Specific prerequisites

Successfully completed courses Energy Resources and Energy Conversion, or other courses with corresponding contents of at least 6 ECTS.

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

After a successfully completed course the students would be able to:

- Identify available technologies and materials for energy storage and their typical application areas together with their advantages and development challenges;
- Assess the need for introducing energy storage within a closed energy system;
- Suggest suitable methods and technologies for energy storage units in a given system;
- Estimate via simplified pathways the necessary dimensions, power capacity and operational parameters for energy storage systems;
- Summarize the demand for further development, potential improvements and possibilities for innovative solutions in the energy storage subject field;
- Evaluate some promising aspects regarding system integration of energy storage solutions with conventional and renewable energy conversion systems and hybrid power plants;
- Calculate efficiency factors and optimization aspects for energy storage units including their integrated solutions within energy conversion systems;
- Valorize economy aspects and deliver a simplified budget assessment for energy storage project development.

Course contents

The course Energy Storage Systems covers the necessary technical knowledge on the fundamental principles and application areas of proven technologies and materials for energy storage solutions, together with an overview of development trends in this engineering field. There is a large need for such tightly focused course content at specific depth and breadth to deliver the condensed knowledge and wide understanding on the very important role that energy storage units are expected to play in the future energy system, including the enormous potential for innovative solutions that this field offers.

This course follows up on and directly complements previously studied courses on energy resources, energy conversion and modern power systems, where an integrated part demands a broad review of energy storage solutions and proper accent on materials technology for energy storage.

The technological aspect of the course blends together fundamental knowledge from the subject areas of mechanical engineering, energy technology, classical thermodynamics, chemical engineering, electrical engineering and power production, with a special focus on the synergy between those and on the integration aspects of various energy storage solutions in the future power system.

More specifically, the course content covers the following main subject fields:
- Kinetic and potential energy storage – pumped hydro, compressed air, flywheel, gravitation;
- Thermal energy storage as sensible heat – high- & low-enthalpy heat, cryogenic, liquid air;
- Thermal energy storage as latent heat – phase change materials;

- Electrochemical processes – electrolysis, fuel cells;
- Chemical energy – hydrogen, synthetic fuels, power-to-gas, thermochemical methods;
- Electrochemical batteries – solid state, flow battery, new technologies;
- Material challenges and necessity for further material development;
- System integration of energy storage solutions with power generation units and grid management.

Course literature

Course literature and suggested reading will be listed in the course syllabus.

Examination

- TEN1 - Examination, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- ÖVN1 - Exercise, 1.0 credits, grading scale: P, F
- ÖVN2 - Exercise, 1.0 credits, grading scale: P, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Exercise 1, 1.0 ECTS, Pass/Fail
Exercise 2, 1.0 ECTS, Pass/Fail
Examination / Final Exam, 2.0 ECTS, graded A-F

Other requirements for final grade

All parts of the course need to be passed

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.