FMJ3386 Energy Storage 6.0 credits

Energilagring

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 FMJ3386 valid from Autumn 2018

Grading scale

P, F

Education cycle

Third cycle

Specific prerequisites

Basics of electricity, chemistry, physics and economy

Basics of thermodynamics and heat transfer

Course participants should be enrolled in a PhD Programme

Language of instruction

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

Intended learning outcomes

After the completion of this course, the course participants should be able to:

- compare fundamental physical and chemical principles behind options for storing energy, including innovative harvesting of excess thermal and electrical energy.
- design of storage concepts for integration in energy conversion applications defined by design challenges from society, industry, and own research area (capacity, efficiency, controls, scale)
- critically appraise the technical, economical, and environmental impact of storage implementation for a variety of energy systems, considering a macro-scale perspective.
- as applied to the Energy Storage field, identifying opportunities for innovation and shaping them into business concepts

Course contents

Effective integration of energy storage in energy systems is a key to sustainability, as it takes care of the mismatch between energy supply and our demands (instantaneous, hourly, daily, weekly, yearly) of energy services like electricity, heat, cold and clean water. However, energy storage is not a fully developed and widely implemented technology with a sufficient number of people competent to realize large scale implementation of new installations for many of the storage options.

Through a vision of large-scale implementation of renewable energy technologies, smart integration of energy storage is required. However, energy can be stored in many ways, using the principles of electrochemical, chemical, thermal, mechanical, and electromagnetic energy storage. Each of these technologies can be further subdivided into specific subgroups, and each technology may have its merits based on the application. To reach the IPCC 2050 goal of 50% + power generation from solar or wind, there would in fact be a need to optimize full conversion chains, from supply to demand for energy services, including demand side management with regards to the need for e.g. heating and cooling in buildings.

The scope of this course is the in-depth assessment of technologies for energy storage, from electrochemical battery technology to storage of heat and cold. For these storage options, the course provides a unique learning opportunity in this very broad scientific field. Fundamental chemical and physical principles of storing energy in materials are described, along with design-to-cost strategies in real applications. In parallel, an in-depth technical analysis integrated with the applied use of industrial dynamics concepts will enable the course participants to set-up effective search and select segments to initiate an innovation process in the area. This is in order to enable business creation in this field which has a forecasted global market potential of 500 billion € by 2030.

Examination

- PRO1 - Project, 6.0 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.

Other requirements for final grade

The students will be examined with a pass or fail criteria, based on the following:

- Active attendance to 75% of the seminars, active participation meaning e.g. giving constructive criticism of presented theories and applications, in group defining achieved learning outcomes per seminar, and formulating topics for further studies.
- Topical leadership of one seminar, discussing the teories of one energy storage option to be assigned at the start of the course.
- Preparation of paper on the State-of-the-Art Assessment of Energy Storage, e.g. with in-depth focus on one technology option or application.
- Active participation in Final Public Seminar "Frontiers in Energy Storage Technology"

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.