MJ2506 Energy Technologies for Sustainable Transportation 6.0 credits

Energiteknik för hållbara transporter

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

On 15/10/2024, Director of First and Second Cycle Education of the ITM School has decided to establish this official course syllabus to apply from Autumn term 2025 (registration number M-2024-1870).

Grading scale

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

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Specific prerequisites

Knowledge equivalent to 3 credits in basic electrical engineering comparable to the sections on electric circuits, electric motors and electric motor control in MF1016 "Electrical Engineering" (9 credits) or MF 1017 "Electrical Engineering" (6 credits).

Language of instruction

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

Intended learning outcomes

The course aims at providing the students with fundamental background and tools for understanding the supply and use of energy for transportation purposes, with a special focus on sustainable solutions.

After completing the course, the student will be able to:

1. Explain the energy flow from source to wheel for various fossil and renewable sources (incl. new/advanced fuels) and transportation applications/systems (road, rail, maritime, aviation and space) and apply relevant system boundaries and determine the efficiency for the energy flow within the system. Explain the impact of emissions (global and local) and energy losses from transportation.
2. Identify and show an understanding of the physical properties and ambient conditions associated with transportation that have a substantial impact on the amount of energy used.
3. Explain the infrastructure needed for different transport options (both roads/tracks etc. and energy supply infrastructure) and the life-cycle influence (in economic, environmental and social terms) related to implementation of such infrastructures.
4. Describe different power train concepts and technologies for energy storage and bi-directional energy flow with their key characteristics and identify positive and negative aspects of on-board energy storage.
5. Identify gaps, bottlenecks and development trends (including digital solutions) towards sustainable transport systems as well as trends that counteract increased sustainability, e.g. increased energy use.

Course contents

The course aims to bring knowledge about the energy needed for transportation in our society and solutions how to provide energy efficient and sustainable transportation. The course starts with an overview of different transportation needs and the state of art solutions for them. The system efficiencies for those solutions and emissions are analyzed with relevant system borders.

Following that, there is an overview of the physical properties and boundary conditions that have a strong influence on the energy consumption for the various kinds of transportation. Infrastructure for transportation is studied, both for the transport itself and for the energy supply infrastructure (the latter is in focus). Investment cost as well as operational cost are addressed together with sustainability aspects. For different vehicles and transportation needs, various powertrain configurations and concepts are being used. An overview of both existing and emerging powertrains are given, with a special focus on the energy related and

sustainability related characteristics and identification of the need for further development and implementation hurdles. The lead-time to phase in new solutions as well as phasing out less desired technologies is discussed.

Examination

- KONA - Quiz, 2.0 credits, grading scale: P, F
- PROA - Project with two submissions, 2.0 credits, grading scale: A, B, C, D, E, FX, F
- TENA - Essay, 2.0 credits, grading scale: A, B, C, D, E, FX, 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.

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.