MJ1145 Energy Systems 7.5 credits

Energisystem

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 MJ1145 valid from Autumn 2011

Grading scale

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

Education cycle

First cycle

Main field of study

Technology

Specific prerequisites

MJ1112 Applied thermodynamics, SK1110 Electromagnetism och wave theory, SF1633 Differetial calculus, DN1212 Numerical methods ans programming, MJ1520 Statitics and Risk Assessment, EI1120 Electrical Circuit Analysis for the Enviroment and Energy Program, KE1060 Material och energy balances (or equivalent courses)

Language of instruction

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

Intended learning outcomes

After completion of the course, the students should be able to:

- exlain how energy systems in Sweden and in the world have developed until today with a focus on technology, energy usage and fuels (primary energy).

- examine the challenges a transition to a more sustainable energy system means for Sweden but also globally.

- be a ble to quantitatively (rought, percentages) for the reation between services and functions in the society and the usage of primary energy.

- able to account for different production technologies (transformation technologies) in terms of function, efficiency and economy.

- account for different distribution technologies (such as electricity, gas and other energy carriers) with regard to function, efficiency and economy;

- explain the link between the use of energy (carriers) and emissions of greenhouse gases

- apply fundamental systems analysis methods for different types of energy systems (setting system boundaries, environment, boundary conditions etc)

- Create simple models of (different) energy systems using different modeling tools and be able to discuss the models' validity and limitations

- describe the local climate's impact on energy use in the built environment and account for the importance of concepts such as of primary energy, transformation losses, emissions trading, energy carriers, renewable energy, entropy production, energy quality and exergy losses, global warming, green and white certificates, etc.

discuss the concepts (states) oil crisis, power shortage, peak power, waste heat, peak oil etc.

- aquire and use various indicators for different types of energy sources and carbon dioxide emissions for different countries from international sources such as IEA / IPCC etc.

- account for historical trends for the relationship between use of primary energy and and economic growth (GDP) for different countries and different regions analyze and critically review forecasts and scenarios in the context of energy model

- discuss energy and sustainability

Course contents

- Basic systems theory and its application to modeling and simulation of energy systems at different scales and different time resolution,

- Methods to measure and calculate the various energy systems benefit / efficiency and the tools to discuss short-and long-term sustainability of energy systems

- General knowledge of how various components in the energy system interacts

A special focus on (i) the coupling of wind energy and intergration in the power system, (ii) energy systems in the city (district heating / cooling and cogeneration), (iii) energy end-usage in society, and (iv) energy use for transportation.

- A comparison of energy systems in different countries and economies in terms of efficiency, technologies, fuels and enviromental impact.

Course literature

to be decided

Examination

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.

5 projects:

Energy usage, modelling (PRO1; 1.5 hp)

Wind energy and the grid, modelling (PRO2; 1.5 hp)

Energy systems in cities, modelling (PRO3; 1.5 hp)

Energy and transport modes and patterns (PRO4; 1.5 hp)

World energy outlook (PRO5; 1.5 hp)

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.