MJ2381 Introduction to Energy Systems Analysis and Applications - Minor Course 6.0 credits

Introduktion till Energisystemanalys och tillämpning - mindre kurs

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 15/10/2021, the Dean of the ITM School has decided to establish this official course syllabus to apply from spring term 2022 (registration number M-2021-2039).

Grading scale

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

Education cycle

Second cycle

Main field of study

Mechanical Engineering

Language of instruction

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

Intended learning outcomes

After passing the course, the student should be able to:

1. Describe well-established methods for energy system modelling and scenario analysis and identify their key benefits and limitations
2. Write a problem formulation for linear optimisation connected to energy system analysis
3. Apply a chosen energy system modelling tools for the analysis of stylised long-term energy planning problems
4. Analyse different selected energy system cases and summarise insights in an appropriate manner, based on limited and uncertain information
5. Include a basic representation of the connections between climate, land use, energy and water in an energy system model

Course contents

The overall objective of this course is to provide the student with solid ground knowledge of Energy Systems Analysis theory and practice, including deep understanding of the working principles of an energy system model.

Below an overview of the topics.

Energy system Analysis
What is it needed for?
How does it support policy makers?
What is an energy system and how can it be represented?
What are energy system models needed for?
What is their role in supporting energy policy?

Types of energy system modelling tools
Bottom-up and top-down modelling tools
Categorisation of energy modelling tools
The Open Source energy Modelling System (OSeMOSYS) as a sample structure.

Designing an energy system optimization problem
Structure of linear optimization energy system models
Creating the algebraic formulation of a linear optimization energy system model from scratch.

Integrated Climate-Land-Energy-Water (CLEWs) modelling
From the representation of an energy system to the representation of several interlinked systems (energy, land and water)
How to model the links between energy, land and water systems in practice?

Scenario analyses
Types of scenario analyses used in energy systems analysis (normative, explorative, predictive)
Examples and outcomes of published scenario analyses.

Critical analysis and review of existing case studies
Reviewing the outcomes, impact and shortcomings of published energy and integrated system modelling analyses.

Creating a sample energy and integrated system model
Group work with OSeMOSYS and an interface designed for it, to create and deeply analyse a sample energy and integrated (CLEWs) system model.

Specific prerequisites

Bachelor of Science in Technology

Knowledge of sustainable development and system analysis corresponding content in courses MJ2413 "Energy and Environment" or MJ2508 "Energy Systems for Sustainable Development"

Knowledge of Linear Algebra, corresponding content in course SF1624 "Algebra and Geometry"

Examination

- PRO1 - Project 1, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO2 - Project 2, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO3 - Project 3, 1.5 credits, grading scale: A, B, C, D, E, FX, F
- PRO4 - Project 4, 1.5 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.