



Faculty of Health, Science and Technology
Environmental and Energy Systems

Syllabus

Optimisation of energy and environmental systems with MATLAB

Course Code:	EMAD24
Course Title:	Optimisation of energy and environmental systems with MATLAB <i>Optimering av energi- och miljösystem med MATLAB</i>
Credits:	10
Degree Level:	Master's level
Progressive Specialisation:	Second cycle, has only first-cycle course/s as entry requirements (A1N)

Major Field of Study:
MEI (Environmental and Energy Systems)

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2021-09-10, and is valid from the Spring semester 2022 at Karlstad University.

Prerequisites

Programme students: 120 ECTS credits completed in the Energy and environmental engineering programme (Bachelor) or 150 ECTS credits completed in the Energy and environmental engineering programme (Master) or admission to the Master programme in Energy and environmental engineering towards a Master degree

Non-programme students: 60 ECTS credits of completed courses, including 7.5 ECTS credits in classical thermodynamics, 15 ECTS credits in energy engineering and 15 ECTS credits in mathematics, or equivalent

Learning Outcomes

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

- apply the computational tool MATLAB to perform graphic processing of data and to handle data sets in the form of vectors and matrices,
- develop new functions in MATLAB as well as handle and apply integrated MATLAB functions,
- develop basic algorithms using if/while/for phrases,
- identify constants and variables of given energy engineering systems,
- identify and model linear equation systems with constraints and objective functions,
- solve linear equation systems to calculate optimal values (maximal/minimal) for the objective function, and
- extend the optimisation model by taking the economic and environmental restrictions of existing systems into account.

Content

The course deals with theory and applications of the computational tool MATLAB, including how to handle and analyse physical input data, analyse dynamic energy and environment systems, write scripts that automatise drives, process output data, and present data effectively in graphic form.

The course includes basic theory about linear optimisation and applications of relevant methods using MATLAB for the optimisation of energy- and environment-related technological systems. Examples of systems to which the methods can be applied are municipal heating networks, refuse and recycling systems, the process industry, power heating plants, purification plants and national and international energy distribution systems.

The course comprises two modules.

Module 1: In-depth review of the computational tool MATLAB, including how to handle vectors/matrices, import and process large data sets, handle graphic visualisation of data and results, develop algorithms based on different principles, create new functions and handle the integrated functions in MATLAB, and formulate and apply ordinary differential equations in MATLAB. Assessment is based on portfolio assignments for which students use MATLAB to analyse and calculate different energy and environmental systems, and present their work in a technical report.

Module 2: Basic instruction of the simplex method, constraints, objective function, state variable and state space. Linear programming of combined energy and environmental optimisation of existing systems. Lectures, laboratory sessions and supervision of project assignment in energy and environment system optimisation with the computational tool MATLAB.

Reading List

See separate document.

Examination

Assessment is based on portfolio assignments, an individual oral exam, a project report, and an oral presentation.

All module components must be completed satisfactorily for a course Pass grade. The course grade is a final appraisal of grades awarded and their credit load weight.

If students have a decision from Karlstad University entitling them to Targeted Study Support due to a documented disability, the examiner has the right to give such students an adapted examination or to examine them in a different manner.

Grades

One of the grades 5 (Pass with Distinction), 4 (Pass with Some Distinction), 3 (Pass), or U (Fail) is awarded in the examination of the course.

Quality Assurance

Follow-up relating to learning conditions and goal-fulfilment takes place both during and upon completion of the course in order to ensure continuous improvement. Course evaluation is partly based on student views and experiences obtained in accordance with current regulations and partly on other data and documentation. Students will be informed of the result of the evaluation and of any measures to be taken.

Course Certificate

A course certificate will be provided upon request.

Additional information

The local regulations for studies at the Bachelor and Master levels at Karlstad University stipulate the obligations and rights of students and staff.