



Faculty of Health, Science and Technology
Environmental and Energy Systems

Syllabus

Thermodynamics and Fluid Mechanics

Course Code:	EMG112
Course Title:	Thermodynamics and Fluid Mechanics <i>Termodynamik och strömningslära</i>
Credits:	15
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has only upper-secondary level entry requirements (G1N)

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

Course Approval

The syllabus was approved by the Faculty of Health, Science and Technology 2020-03-11, and is valid from the Autumn semester 2020 at Karlstad University.

Prerequisites

General admission requirements and upper secondary level Mathematics 3c, Physics 2, and Chemistry 1 (field-specific eligibility A8)

Learning Outcomes

The aim of the course is for students to acquire basic knowledge of concepts and methods related to energy technology. The course offers students the opportunity to practice problem-solving in applied thermodynamics and heat and fluid mechanics.

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

- calculate the energy content and changes in it for different materials and fluids, including phase

transition,

- use the state equation of ideal gases,
- identify and calculate the energy flows of an open system,
- draw up energy and mass balances for open and closed systems,
- calculate supplied or delivered work and heat for a system,
- give an account of possibilities and limitations of energy transitions, expressed in the first law of thermodynamics,
- calculate thermal conductivity through plane and circular layers,
- calculate basic cases of heat transfer through conductivity, convection, and radiation,
- calculate effect for heat exchangers, based on flow and temperature on the hot and cold side,
- calculate pressure in fluids in stationary systems, and forces on surfaces touched by fluids,
- explain the concepts of static, dynamic, and total pressure,
- give an account of how the properties of fluids affect their flow,
- give an account of the no slip condition,
- give an account of laminar and turbulent flow and break criteria,
- interpret the continuity equation and Bernoulli's equation, and use them for calculations,
- describe and apply different methods for measuring the pressure and flow of fluids,
- give an account of different types of flow regulation,
- use dynamic similarities and dimension analysis for problem-solving,
- calculate friction pressure drop in connection to internal flow,
- dimension pumps and fans,
- describe the function of a hydroelectric plant and calculate extracted effect and energy,
- describe the function of a wind-powered plant and calculate extracted effect and energy,
- give an account of the Swedish energy system regarding the supply, conversion, and utilisation of energy,
- handle energy technology such as heat pumps, refrigeration units, boilers, heat and power stations, gas turbines, solar collectors, solar cells, wind turbines and so on as black boxes with conversion factors in order to be able to analyse the national energy system,
- use Excel (or equivalent software) as a calculation tool,
- write a technical report focused on methodology and results, and
- apply measuring accuracy in connection with laboratory work.

Content

The course covers the following:

- Conduction, convection, and radiation
- Forms of energy, energy conversion, energy content, phase conversion, and enthalpy
- Ideal gases, the state of a substance, equilibrium
- Open and closed systems, system boundaries, mass and energy balances
- The first law of thermodynamics
- Energy equations
- Energy and effect
- The properties of fluids, viscosity, incompressibility
- Hydrostatics
- The continuity equation
- Bernoulli's equation
- Pump and fan curve, system curve, operating point
- Cavitation
- The Swedish energy system, electricity production plants, heat and cold, basic circuit diagram, efficiency, and resource flows
- Hydroelectric power and wind power

Reading List

See separate document.

Examination

Assessment is based on a written exam and written and oral presentations of hand-in assignments.

If students have a decision from Karlstad University entitling them to special pedagogical 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 Pass with Distinction (5), Pass with Some Distinction (4), Pass (3), or Fail (U) 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.