Faculty of Health, Science and Technology
Environmental and Energy Systems

Syllabus

Energy for sustainable development

Course Code:	EMG211
Course Title:	Energy for sustainable development *Energiteknik för hållbar utveckling*
Credits:	30
Degree Level:	Undergraduate level
Progressive Specialisation:	First cycle, has less than 60 credits in first-cycle course/s as entry requirements (G1F)

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

Course Approval
The syllabus was approved by the Faculty of Health, Science and Technology 2017-03-13, and is valid from the Autumn semester 2017 at Karlstad University.

Prerequisites
Course attendance 60 ECTS credits for the Bachelor Programme in Energy and Environmental Engineering with 15 ECTS credits completed.

Learning Outcomes
The aim of the course is that students develop their fundamental knowledge of thermodynamics and heat and mass transfer, broaden and enhance their knowledge of concepts and facts and be acquainted with using standard problem solving methods and systems analysis for energy engineering systems and energy for sustainable development.

Knowledge and understanding
Upon completion of the course, students should be able to:
- give an account of the possibilities and limitations in energy conversion expressed through the main theorems of thermodynamics,
- explain the importance of equilibrium in thermodynamic processes and cycles,
- describe the function of energy engineering systems and their components such as compressors, turbines, heat exchanger, steam boilers, coolers etc and relevant accessories,
- give an account of the importance of the isentropic effect in thermodynamic processes and cycles,
- give an account of the production and distribution of bioenergy,
- describe how the design and construction of combustion plants affect the emission of environmentally harmful substances,
- describe how district heating net/distribution of heat can be adjusted to varying needs of effects.

Competence and skills

Upon completion of the course, students should be able to:
- set up energy and mass balances and enthropy balances for open and closed systems,
- analyse thermodynamic cycles such as the Rankine cycle, cooling cycles and Camot cycles,
- calculate and analyse heat transfer via conductors, convection and radiation,
- calculate and analyse mass transfer in the form of steam via diffusion and convection,
- apply knowledge of heat and fluid engineering in dimensioning the components of energy engineering systems,
- interpret and use Fourier's heat conduction equation,
- calculate basic combustion and gasification processes,
- interpret and describe energy engineering sysgtems using a process model,
- write a report according to scientific conventions.

Judgement and approach
Upon completion of the course, students should be able to:
- assess energy efficient projects in terms of thermodynamic limitations and sustainability principles,
- create system solutions/system analysis for sustainable energy engineering system,
- estimate the total thermal efficiency of energy sources,
- give arguments for the choice of component such as pumps, compressors and heat exchangers in energy engineering systems.

Content
Students work individually or in groups on project tasks, presented orally and in writing, in the following areas:
- classical thermodynamics
- one-dimensional stationary heat transfer
- transient heat transfer
- two-dimensional stationary heat transfer
- mass transfer via diffusion
- dimensionless numbers
- heat exchanger
- cooling tower
- cooling machines
- ideal and real gases
- gas transformation
- Rankine cycles
- cooling cycles

Reading List
See separate document.

Examination
Assessment is based oral and written project reports, individually and in groups, and a written exam.

Project assignments are graded Fail or Pass.
Written exams are graded Fail, 3, 4,or 5.

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.