Reg No: EMG133/20251

Faculty of Health, Science and Technology
Environmental and Energy Systems

Syllabus

Basic heat and mass transfer

Course Code:	EMG133
Course Title:	Basic heat and mass transfer *Grundläggande värme- och masstransport*
Credits:	15
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 2024-08-26, and is valid from the Spring semester 2025 at Karlstad University.

Prerequisites
Registered for 15 ECTS credits in the Bachelor programme in Energy and Environmental Engineering, or equivalent

Learning Outcomes
The aim of the course is for students to acquire an understanding of the physical phenomena heat conduction, heat convection, heat radiation, mass diffusion, and mass convection as well as the movement of fluids in boundary layers.

Upon completion of the course, students should be able to:
- establish energy and mass balances for open and closed systems,
- explain the concepts of static, dynamic, and total pressure,
- give an account of laminar and turbulent flow as well as transition criteria,
- describe and distinguish between the basic mechanisms of heat transfer, heat conduction,

heat
convection and heat radiation,
- describe and distinguish between the basic mechanisms of mass transport, diffusion and convection,
- describe how boundary layers emerge and develop for internal and external flow, and their significance for flow resistance, heat transfer and mass transfer between a surface and surrounding fluid, using the concepts no-slip, shear stress, viscosity, and friction coefficient,
- describe the emergence of deplacement forces and natural convection,
- calculate the heat transfer coefficient for natural and forced convection,
- estimate the heat transfer coefficient for condensation and boiling,
- calculate radiation exchange between surfaces, based on their radiation technical properties and geometric relations,
- calculate combined heat transfer in terms of heat conduction, heat convection, and heat radiation,
- describe the function of different types of heat exchangers,
- dimension and analyse heat exchangers,
- use Excel for calculating dimensions and analyses,
- write a technical report focused on methodology and results,
- demonstrate good oral communication skills, and
- offer constructive comments on technical reports in the area.

Content
The course covers the following:
- open and closed systems, system boundaries, mass and energy balances,
- energy and power,
- properties of fluids, viscosity, and incompressibility,
- mechanisms for heat transfer from a warm to a cold body, conduction, natural and forced convection, and radiation,
- mechanisms for mass transfer from high to low concentration, diffusion and convection,
- the air-water system and Mollier diagram,
- calculation of combined heat transfer and heat and mass transfer,
- dimensioning and analysis of different types of heat exchangers, and
- the function of solar collectors and solar cells.

Reading List
See separate document.

Examination
Assessment is based on an individual written exam and written and oral presentations of hand-in assignments.

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 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.