



Faculty of Health, Science and Technology  
Environmental and Energy Systems

# Syllabus

## Heat- and Mass Transfer

<b>Course Code:</b>	EMG132
<b>Course Title:</b>	Heat- and Mass Transfer <i>Värme- och masstransport</i>
<b>Credits:</b>	15
<b>Degree Level:</b>	Undergraduate level
<b>Progressive Specialisation:</b>	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 2020-03-11, and is valid from the Autumn semester 2020 at Karlstad University.

### Prerequisites

Registered on Thermodynamics and Fluid mechanics (15 ECTS credits) and Sustainable Development for Engineering (7.5 ECTS credits), or equivalent

### Learning Outcomes

The aim of the course is that students 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. Students practice the application of connections that describe these phenomena, and the course is based on and applies knowledge from previous course in Fluid Mechanics.

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

- 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 displacement 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,
- describe energy technology systems for using solar energy, and calculate the annual energy exchange from these types of facilities,
- use Excel (or equivalent software) for calculating dimensions and analyses,
- write a technical report focused on methodology and results,
- demonstrate good oral communication skills, and
- offer constructive comments on the work of others.

### **Content**

The course covers the following:

- 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,
- dimensioning and analysis of solar collectors,
- the function and energy exchange of 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 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.