MJ1401 Heat Transfer 6.0 credits

Värmeöverföring

This is a translation of the Swedish, legally binding, course syllabus.

If the course is discontinued, students may request to be examined during the following two academic years

Establishment

Course syllabus for MJ1401 valid from Autumn 2019

Grading scale

A, B, C, D, E, FX, F

Education cycle

First cycle

Main field of study

Mechanical Engineering,Technology

Specific prerequisites

The course MJ1112 Applied thermodynamics or the equivalent

Language of instruction

The language of instruction is specified in the course offering information in the course catalogue.

Intended learning outcomes

To give an understanding of how the heat transfer takes place, be able to analyse a real heat transfer problem, identify, explain and compare different heat transfer phenomena and discuss heat transports in general. It implies that the student can apply theory from the course to analyse real heat transfer problems.

After the course, the students should be able to:

Identify, formulate, model and solve problems for different heat transfer mechanisms, as well as design devices with heat exchange.

Course contents

One-dimensional cases at stationary conditions.

Differential equations for heat conduction in solid materials.

Solutions for different special cases. Fin efficiency for different fin designs

Two and three-dimensional cases at stationary conditions.

Laplace's equation. The form factor. Numerical solution methods and analogy methods.

Non-stationary cases. Solutions for flat surfaces and cylinders

Superposition of elementary cases. The ”Lumped heat capacity” method

Numerical solution methods.

Convection, radiation, boiling, condensation and heat exchangers

Velocity and temperature boundary layers.

Theoretical treatment of flow over a flat plate at laminar and turbulent flow.

Reynold's analogy between heat transfer and pressure drop.

Empirical relationships for heat transfer at induced flow

Laminar and turbulent flow in pipes and ducts. Flow around bodies

Velocity profiles and entrance regions Hydraulic diameter

Heat transfer at free convection, Grashof number, boundary layer equations in integral form with solutions for free convection at vertical plates

Empirical relationships for laminar and turbulent boundary layers at vertical and horizontal plates, cylinders and slots

Heat transfer at radiation

The "black body" concept. Emission and absorption numbers. Radiant efficiency, angular factor.

Heat transfer in falling films

Heat transfer at condensation

Nusselt's theory, condensation on and in horizontal pipes

Heat transfer at boiling

Various types of boiling, the boiling curve

Pool boiling, cooking in pipes and ducts

Heat exchangers

Different types, logarithmic mean temperature difference, temperature effectiveness, NTU

Disposition

The course is given during fall semester, 2nd quarter. The course includes lectures (32 h), exercises (32 h) and four laboratory sessions and three quizzes and an examination. The lectures present the general ideas and theoretical explanations behind heat transfer. In the exercises the theory is applied for different heat transfer problems.

Course literature

Yunus A. Cengel; Afshin J. Ghajar; Heat and Mass Transfer, Fundamentals and applications; Mc Graw Hill companies.

Examination

- LAB2 - Laboratory work, 0.5 credits, grading scale: P, F
- TEN2 - Written exam, 5.5 credits, grading scale: A, B, C, D, E, FX, F

Based on recommendation from KTH's coordinator for disabilities, the examiner will decide how to adapt an examination for students with documented disability.

The examiner may apply another examination format when re-examining individual students.

Examination consists of five comprehensive arithmetical problems. During the course, three quizzes that give bonus points on the examination are given. Bonus points received for quizzes during one academic year are valid throughout that academic year (regular and re-examination).

Language of instruction: Swedish and English

Lectures: Swedish

Exercises: English or Swedish (depending on the assigned teacher)

Reading list: English

Lab exercise instructions and lab exercises: English

Quizzes and written examination: English

Other requirements for final grade

A written examination (TEN1; 5.5 credits) with arithmetical problems. For final mark, passed Labs are required (LAB1; 0.5 credits). Three quizzes are organised, whose result may be included at examination. Passed quizzes give bonus points on examination.

Ethical approach

- All members of a group are responsible for the group's work.
- In any assessment, every student shall honestly disclose any help received and sources used.
- In an oral assessment, every student shall be able to present and answer questions about the entire assignment and solution.