LUNDS UNIVERSITET
Lunds Tekniska Högskola

Course syllabus

Värmeöverföring
Heat Transfer

MMVF05, 7,5 credits, G2 (First Cycle)

Valid for: 2023/24
Faculty: Faculty of Engineering, LTH
Decided by: PLED M
Date of Decision: 2023-04-11

General Information

Main field: Technology.
Elective Compulsory for: M3
Elective for: F4, F4-bem, MLIV1
Language of instruction: The course will be given in English

Aim

The course aims to provide knowledge and understanding about the mechanisms of heat transfer, including conduction, convection, radiation, and phase change. The course covers the analytical and empirical methods, which are used to solve heat transfer problems, such as determining the amount of heat being transferred and the temperature field. The students will learn how to apply the theory to relevant engineering problems.

Learning outcomes

Knowledge and understanding
For a passing grade the student must

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- understand the theory of steady and transient heat conduction
- understand the theory of laminar and turbulent convection in boundary layers, in pipes and in external flow around bodies
- understand the basics of thermal radiation between surfaces
- understand the basic heat exchanger theory
- understand the basics of condensation and boiling
- understand under what conditions analytical or empirical methods are applicable

- be able to describe the role of heat transfer in industry

Competences and skills
For a passing grade the student must

For a passing grade the student must

- analyse different heat transfer problems and suggest solution methods
- solve heat transfer problems that involve conduction, convection, radiation, condensation and/or boiling in a systematic way
- judge the uncertainties in the magnitude of heat fluxes and heat transfer coefficients where applicable
- present analysis and solution of heat transfer problems in writing

Judgement and approach
For a passing grade the student must

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- critically review chosen methods and results of calculations of heat transfer problems and point out sources of uncertainty
- understand the assumptions behind different theories and the limitations they imply
- orally and in written form present analysis of basic issues concerning heat transfer

Contents

The course covers heat conduction, convection, thermal radiation, condensation, boiling and heat exchangers.

For heat conduction the general theory, extended surfaces and transient heating and cooling processes are included.

For the convective heat transfer the basic equations, similarity laws, forced and free convection and the basics of turbulence are included. Laminar as well as turbulent cases are studied in internal (ducts) and external (tubes, immersed bodies) flows.

Thermal radiation covers general theory, black and grey bodies, view factors, radiative exchange between surfaces as well as radiation with non-transparent gases.

For condensation the basic theory on film condensation and influence of essential parameters and the geometry is included. Introduction to dropwise condensation is provided.

For boiling, the different boiling regimes are covered by means of the Nukiyama curve.

The critical heat flux and the boiling crisis are covered.

Heat exchangers of various types for engineering applications are described and the basic theory and methods for sizing and rating of heat transfer equipment are included.

Examination details

Grading scale: TH - (U,3,4,5) - (Fail, Three, Four, Five)
Assessment: A written exam including theoretical questions and problems to be solved has to be passed. As the theoretical questions are handled closed books prevail. For the problem solving part, the course book and supplied tables are permitted. The exam must therefore be splitted up in two parts. This requires that first the theoretical part is solved with closed books and as soon as this part is finished and handed in to the assistant, the problem solving part can start. The book is then permitted as well as the supplied tables and a pocket calculator. Solved problems are not permitted. The home work or assignments concern solving of a few problems from the collection of heat transfer problems and a few theoretical tasks. Every student must hand in an own solution to every assignment. The teachers will correct and approve the tasks.

The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.

Parts
Code: 0117. **Name:** Heat Transfer.
Credits: 5,5. **Grading scale:** TH. **Assessment:** Assessment: A written exam including theoretical questions and problem solving has to be passed. During the exam a sheet with formulas, tables and graphs will be provided. A pocket calculator is also permitted. No book or other material is permitted on the exam. There are also mandatory homework assignments that need to be passed. Every student must hand in their own solution unless otherwise stated. Teachers will correct and approve the tasks. The examiner, in consultation with Disability Support Services, may deviate from the regular form of examination in order to provide a permanently disabled student with a form of examination equivalent to that of a student without a disability.
Code: 0217. **Name:** Heat Transfer - Home Assignments.
Credits: 2. **Grading scale:** UG. **Assessment:** Home assignments

Admission

Admission requirements:

- FMFF05 Thermodynamics with Applications or MMVF01 Thermodynamics and Fluid Mechanics

The number of participants is limited to: No

Reading list

- Yunus Cengel, Afshin Ghajar: Heat and Mass Transfer, Fundamentals and Applications.

Contact and other information

Course coordinator: Thommie Nilsson, thommie.nilsson@energy.lth.se
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Examinator: Martin Andersson, martin.andersson@energy.lth.se
Course homepage: https://www.energy.lth.se/english/education/

Further information: The course includes lectures, tutorial sessions, self studies, home work assignments. Some chapters are for self studies with compulsory assignments.