EPFL

ME-446

Two-phase flows and heat transfer

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Cursus	Sem.	Type
Energy Management and Sustainability	MA1, MA3	Opt.
Energy minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	5
Withdrawal	Unauthorized
Session	Winter
Semester	Fall
Exam	During the semester
Workload	150h
Weeks	14
Hours	**5 weekly**
Courses	4 weekly
Project	1 weekly
Number of positions	

It is not allowed to withdraw from this subject after the registration deadline.

Summary

This course covers the theoretical and practical analysis of two-phase flow and applications. Fundamental two-phase heat transfer in the form of condensation and boiling are studied in detail. Advanced topics such as microchannel two-phase flow, microfinned tubes and oil effects are also handled.

Content

1. Introduction to two-phase flow patterns (annular, mist, bubbly, stratified, etc).
2. Two-phase flow pattern maps and transition theory.
3. Homogeneous and heterogeneous flow models.
4. Film condensation (Nusselt equation, multitube models, condensation on enhanced fin geometries).
5. Convective condensation (flow pattern effects, various models and methods for plain and internally enhanced channels).
6. Fundamentals of pool boiling (nucleation, bubble dynamics, nucleate boiling, peak heat flux models, film boiling).
7. Convective boiling (heat transfer models and design methods for evaporation inside tubes and outside tube bundles).
8. Combined heat and mass transfer in phase change processes (condensation in presence of non-condensable gas and evaporation of mixtures.

Keywords

Two-phase heat transfer, two-phase flow, condensation, convection, evaporation

Learning Prerequisites

Recommended courses

- Heat and mass transfer (ME-341)

Important concepts to start the course

Basic understanding of:

- the physics of heat conduction and fluid flow
- thermodynamics of pure fluids
- mass, momentum, and energy conservation on both differential and finite control volume basis

Familiarity with engineering conventions for representing heat transfer, particularly in pipes, such as heat transfer coefficient, friction factor, Reynolds number, Nusselt number, etc.
Basic skills in MATLAB or a computer langauge of your choice.

Learning Outcomes

By the end of the course, the student must be able to:

- Model fluid flows in energy conversion systems, compute pressure drops and heat losses and fluid-structure interactions, E10
- Explain and apply the concepts of heat and mass transfer, E3
- Design and calculate heat exchangers, E15

Transversal skills

- Make an oral presentation.
- Negotiate effectively within the group.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.

Teaching methods

The course is organized with lectures plus student projects in groups.

Assessment methods

Oral presentation of group project

Supervision

Office hours	Yes
Assistants	Yes
Forum	No

Resources

Bibliography

Free net book "Engineering Databook III": John R. Thome,
http://www.wlv.com/products/thermal-management-databooks.html

Ressources en bibliothèque

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