ME-446

Two-phase flows and heat transfer

Lu Zhengmao

Cursus	Sem.	Type
Energy Science and Technology	MA1, MA3	Opt.
Mechanical engineering minor	H	Opt.
Mechanical engineering	MA1, MA3	Opt.

Language of teaching	English
Credits	3
Session	Winter
Semester	Fall
Exam	Written
Workload	90h
Weeks	14
Hours	**3 weekly**
Lecture	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course covers the fundamental and practical analysis of two-phase flow and heat transfer in various contexts including power generation, water purification, and cooling. Students will learn about the multiscale physics involved in evaporation, boiling, and condensation.

Content

1. Introduction to liquid-vapor phase change phenomena
2. Capillarity and wetting
3. Evaporation physics (diffusion-based model, kinetic theory treatment)
4. Homogeneous and heterogeneous nucleation
5. Pool boiling (onset of nucleation, nucleate boiling, critical heat flux,...)
6. Condensation (filmwise, dropwise, jumping droplet)
7. Flow boiling (flow regimes, pressure oscillation,...)

Keywords

Interfacial phenomena, evaporation, boiling, condensation

Learning Prerequisites

Required courses

Undergraduate level courses in fluid mechanics and heat transfer

Recommended courses

Important concepts to start the course

Basic understanding of:

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

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:

- Explain a variety of capillarity-driven interfacial phenomena
- Analyze energy transport mechanisms in liquid-vapor phase change
- Model heat and mass transfer during phase change
- Optimize phase-change component of certain energy and water systems

Transversal skills

- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Demonstrate the capacity for critical thinking
- Communicate effectively, being understood, including across different languages and cultures.
- Use both general and domain specific IT resources and tools

Teaching methods

The course is organized with lectures and exercises.

Assessment methods

50% Homework + 50% Final Exam.

Supervision

Assistants	Yes

Resources

Bibliography

1. Liquid-Vapor Phase-Change Phenomena**,** An Introduction to the Thermophysics of Vaporization and Condensation Processes in Heat Transfer Equipment, Third Edition By Van P. Carey
2. A heat transfer textebook Version 5.10, Lienhardt IV and Lienhardt V, https://ahtt.mit.edu/

Ressources en bibliothèque

- A heat transfer textbook, Lienhardt V (5th edition)
- Liquid-Vapor Phase-Change Phenomena, Carey
- A heat transfer textbook, Lienhardt IV (4th edition)