CIVIL-450

Thermodynamics of comfort in buildings

Khovalyg Dolaana

Cursus	Sem.	Type
Civil Engineering	MA2, MA4	Opt.
Mechanical engineering	MA2, MA4	Opt.
Minor in Integrated Design, Architecture and Sustainability	E	Opt.

Language of teaching	English
Credits	3
Session	Summer
Semester	Spring
Exam	During the semester
Workload	90h
Weeks	14
Hours	**3 weekly**
Courses	2 weekly
Exercises	1 weekly
Number of positions	

Summary

This course provides an integrated approach to analyzing human indoor thermal comfort by examining the correlation between human thermoregulation, heat exchange with the indoor environment, overall and local thermal sensation of occupants.

Content

- Overview of the heat exchange between the humans and the environment
- Definition of indoor thermal comfort, its requirements, and objective characterization
- Thermal conditioning in buildings, heating and cooling people, emission systems
- Integrated analysis of indoor thermal environment and human comfort using actual data from lab measurements

Keywords

Human thermal comfort, ergonomics of indoor thermal environment, indoor climatization, heat transfer, energy

Learning Prerequisites

Required courses

- Heat and mass transfer (ME-341)

Recommended courses

- General physics: thermodynamics (PHYS-106)
- Building physics (PHYS-118)
- Thermodynamics and energetics (ME-251)
- Comfort and architecture: sustainable strategies (AR-442)
- Urban thermodymanics (CIVIL-309)
- Building energetics (ENG-445)

Important concepts to start the course

Heat transfer, human comfort, indoor thermal environment, heating/cooling needs of buildings

Learning Outcomes

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

- Characterize local thermal environment and comfort
- Assess / Evaluate energy to provide thermal comfort to people
- Carry out measurements of indoor comfort and energy performance using diagnostic instrumentation
- Take into consideration the effect of various modes of heat transfer on human body
- Perform data analysis and presentation

Transversal skills

- Write a scientific or technical report.
- Make an oral presentation.
- Plan and carry out activities in a way which makes optimal use of available time and other resources.
- Demonstrate the capacity for critical thinking

Teaching methods

- Lectures on theoretical introduction to the topics of heating and cooling in buildings, human energy balance, thermal comfort, and transient performance of the buildings.

- Practical activities at the EPFL-Fribourg campus, in facilities of the Laboratory of Integrated Comfort Engineering and Smart Living Lab, to enrich understanding on dynamic indoor environment and the associated energy expense to maintain comfortable conditions.

Expected student activities

- Attend lectures and laboratory activities
- Work in groups on practical activities, analysis of data, reporting, and presentation

Assessment methods

- Presentation and report on lab work #1: **30%**
- Presentation and report on lab work #2: **50%**
- Quiz on the course material: **20%**

Supervision

Office hours	Yes
Assistants	No
Forum	No

Resources

Virtual desktop infrastructure (VDI)

No

Bibliography

- Lecture notes (primary source)
- P. O. Fanger, Thermal Comfort, Danish Technical Press, 1970

• K. Parsons, Human Thermal Environments (Third Edition), CRC Press, 2022
• Y. A. Çengel; A. J. Ghajar, Heat and Mass Transfer: Fundamentals and Applications, McGraw Hill Education, 5th edition.
• M. Moran, H. N. Shapiro, D. D. Boettner, M.B. Bailey, Fundamentals of Engineering Thermodynamcis, John Wiley & Sons, 7th edition.

Ressources en bibliothèque

- Thermal Comfort / Fanger (1970)
- Fundamentals of Engineering Thermodynamics / Moran et al. (8th ed., 2014))
- Heat and Mass Transfer: Fundamentals and Applications / Çengel (5th ed., 2015)
- Human Thermal Environments / Parsons (3rd ed., 2014)

Moodle Link

- https://go.epfl.ch/CIVIL-450

Prerequisite for