CIVIL-309

Urban Thermodynamics

Khovalyg Dolaana

Cursus	Sem.	Type
Civil Engineering	BA5	Obl.

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

Summary

The course analyzes urban neighborhoods from a thermodynamics perspective, focusing on heat exchange among buildings, vegetation, water, ground, environment, and people. Agroup project highlights the Urban Heat Island effect and mitigation strategies for human comfort and building performance

Content

- Analysis of urban physical processes at various scales
- Features of the urban environment and urban micro-meteorology
- Thermal interactions among environment, buildings, vegetation, ground, and water surfaces
- Spatial distribution and dynamics of airflow, temperature, and humidity in urban areas
- Influence of materials and urban design on thermal heat exchange and the environmental quality
- Impact of urban elements on urban climate and outdoor comfort

Keywords

Urban heat exchange, built environment, heat island effect, outdoor environmental quality, climate-sensitive urban design

Learning Prerequisites

Required courses

- General physics: thermodynamics PHYS-106

Recommended courses

- Mécanique des fluides (pour GC) CIVIL-210
- Fundamentals of indoor climate CIVIL-212

Important concepts to start the course

Heat exchange, convection, conduction, radiation, evaporation

Learning Outcomes

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

- Assess / Evaluate various modes of heat transfer in the urban environment.
- Assess / Evaluate surface energy balance at various urban interfaces.
- Carry out thermodynamics analysis at the urban scale.
- Critique the choice of urban materials and design and propose alternative solutions.
- Examine the effect of the outdoor built environment on human comfort

Transversal skills

- Demonstrate the capacity for critical thinking
- Evaluate one's own performance in the team, receive and respond appropriately to feedback.
- Assess one's own level of skill acquisition, and plan their on-going learning goals.
- Identify the different roles that are involved in well-functioning teams and assume different roles, including leadership roles.
- Take responsibility for environmental impacts of her/ his actions and decisions.
- Take account of the social and human dimensions of the engineering profession.

Teaching methods

Ex cathedra, exercices, discussions, computational tools

Expected student activities

Participate in discussions, exercise and computer simulation sessions, group work

Assessment methods

Written test (30% of the total grade) and group project report (70% of the total grade)

Supervision

Office hours	No
Assistants	Yes
Forum	No

Resources

Virtual desktop infrastructure (VDI)

Yes

Bibliography

- T.R. Oke, G.Mills, A. Christensen, J.A. Vooght, **Urban Climates**, Cambridge University Press
- S. Medved, **Building Physics: Heat, Ventilation, Moisture, Light, Sound, Fire, and Urban Microclimate**, Springer
- A. Rodrigues, R.A. Sardinha, G. Pita, **Fundamental Principles of Environmental Physics,** Springer
- N. Mason, P. Hughes, **Introduction to Environmental Physics: Planet Earth, Life and Climate,** Taylor & Francis

Ressources en bibliothèque

- Urban Climates / Oke, Mills,Christensen
- Building Physics / Medved
- Fundamental Principles of Environmental Physics / Rodrigues, Sardinha, Pita

- Introduction to Environmental Physics / Mason, Hughes

Moodle Link

- https://go.epfl.ch/CIVIL-309

Prerequisite for