Summary
This course introduces the analysis of urban areas from a thermodynamics perspective, considering the heat exchange between different urban elements (buildings, vegetation, water surfaces, ground, and environment). Urban heat island effect and outdoor comfort topics are also discussed.

Content
- Urban physical processes at different scales, and their analysis
- Characteristics of the urban environment and urban micro-meteorology
- Environment-buildings-vegetation-ground-water surfaces thermal interaction
- Spatial distribution and dynamics of airflow, temperature, and humidity in cities
- Role of materials and urban design in thermal heat exchange
- Effect of urban elements on urban climate, outdoor comfort

Keywords
Urban heat exchange, urban atmosphere/boundary layer, urban elements interaction, environmental impact, built environment, urban green areas and water bodies, urban heat island (UHI) effect, outdoor thermal comfort

Learning Prerequisites
Required courses
- General physics: thermodynamics PHYS-106

Recommended courses
- Fluid mechanics (for GC) CIVIL-210
- Fundamentals of indoor climate CIVIL-221

Important concepts to start the course
Heat transfer modes (convection, conduction, radiation)

Learning Outcomes
By the end of the course, the student must be able to:
• Assess / Evaluate heat distribution in urban zones
• Critique the choice of urban materials and design and propose alternative solutions
• Analyze various modes of heat transfer in urban environment
• Carry out thermodynamic analysis at urban scale
• Examine the effect of the outdoor built environment on human comfort
• Assess / Evaluate surface energy balance at various urban surfaces

Transversal skills
• Assess one's own level of skill acquisition, and plan their on-going learning goals.
• Demonstrate the capacity for critical thinking
• Access and evaluate appropriate sources of information.

Teaching methods
Ex cathedra and exercises in class

Expected student activities
Participate in lectures and exercise sessions

Assessment methods
Three written tests: 30%+45%+25%

Supervision
Office hours No
Assistants Yes
Forum No

Resources
Virtual desktop infrastructure (VDI)
No

Bibliography
• 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
• S. Medved, Building Physics: Heat, Ventilation, Moisture, Light, Sound, Fire, and Urban Microclimate, Springer
• N. Mason, P. Hughes, Introduction to Environmental Physics: Planet Earth, Life and Climate, Taylor & Francis
• A. Rodrigues, R.A. Sardinha, G. Pita, Fundamental Principles of Environmental Physics, Springer

Moodle Link
• https://go.epfl.ch/CIVIL-309

Prerequisite for
• Building energetics ENG-445
• Thermodynamics of comfort in buildings CIVIL-450

NB: ce cours ne sera pas dispensé en 2023-2024