ESIROI
ÉCOLE D'INGÉNIEURS
UNIVERSITÉ DE LA RÉUNION

DEPARTMENT : *CPI*
SEMESTER : *S4*

IDENTIFICATION

Course code :	E2CP4B7
ECTS :	2.5

DURATION

Lectures :	10
Tutorial classes :	12
Labs :	8
Total :	30

Project :
Personnal work :

ASSESSMENT

2 Written exams (2h/2h) + 1 Lab report

TEACHING MATERIALS

LANGUAGE

English

CONTACT

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UE : BATIMENT-ENERGIE

COURSE : Advanced Heat Transfer I

SCOPE OF THE COURSE

OBJECTIVES

1. Heat transfer equation in an immobile and isotropic solid.
2. Thermal resistances and conductances.
3. **Convection**
   - Newton's law.
   - Principle of convection.
   - Characteristic numbers.
4. **Thermal radiation**
   - Radiation quantities ; Planck's, Wien's, Stefan–Boltzmann, and Kirchhoff's laws.
   - Exchanges between black bodies and between grey bodies.
5. **Laboratory work**
   - Measurement of heat transfer coefficients.
   - Simulation of thermodynamic systems.

COMPETENCE AND SKILLS

- Propose a simplified model for a thermal system in steady state.
- Solve a 1D steady-state heat transfer problem under classical boundary conditions (convection, imposed temperature, imposed flux).
- Evaluate a convective heat transfer coefficient using standard experimental correlations.

PROGRAM

- Review and framework : steady-state 1D conduction, heat equation in steady state, boundary conditions (Dirichlet, Neumann, Robin).
- Thermal resistance method : plane, cylindrical, and spherical walls ; multilayer systems ; simple volumetric generation ; thermal contact.
- Solving typical 1D cases : imposed temperature or flux, convection at the boundary (Robin condition), superposition and balance verification.
- Convection : Newton's law, dimensional analysis and dimensionless numbers (Re, Pr, Nu) ; flow regimes (laminar/turbulent) ; introduction to standard correlations (internal/external flows).
- Evaluation of the coefficient h : step-by-step procedure (regime selection, properties, characteristic length, correlation, calculation of Nu then h) ; uncertainty estimation.
- Integrated application : calculation of a wall with convection on both sides (simplified model, resistance network, 1D resolution, order-of-magnitude check).
- Guided exercises and mini-project (spreadsheet/script) : solving and validating real-world cases, concise presentation of results.

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BIBLIOGRAPHY

REQUIREMENTS

— Balances and transfers.
— Partial derivatives and differential equations.

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