Name	*Heat Transfer and exchangers*
ECTS credits	*5*
Year / Semester	*I /2°*
Specific learning outcomes	*On successful completion of this module students should be able to:* *1 – Demonstrate knowledge and understanding of the fundamentals of the heat transfer discipline and of the fundamental hypothesis of the one-dimensional calculation approach* *2 – Recognize the different modes of heat transfer* *3 – Calculate heat exchange in different unfamiliar configurations and under assigned boundary conditions, by choosing the most suitable numerical or analytical method* *4 – Propose solutions to limit/enhance heat exchange in complex systems (e.g. heat exchangers, finned surfaces, etc.)* *5 – Interpret technical diagrams for the estimation of relevant parameters (e.g. efficiency, friction factor, etc.)* *6 – Illustrate the fundamentals of the heat transfer discipline and of the fundamental hypothesis of the one-dimensional calculation approach* *7 – Participate in class discussions with colleagues and with teachers*
Contents	*Derivation of heat conduction equation; heat conduction in one dimensional systems; concept of thermal resistance; transient heat conduction with lumped system approach and model of the "semi-infinite" body; heat exchange from finned surfaces; forced convection on surfaces; theory of the boundary layer; laminar and turbulent flows; non dimensional parameters in forced convection; internal forced convection; natural convection over surfaces and in enclosures; non dimensional parameters in natural convection; performance and calculation of heat exchangers; The log mean temperature difference ΔT_{lm} (LMTD); The Kern Method.*
Teaching and learning methods	*Face to face, 60 hours*
Teaching techniques	*Lectures, 35 hours* *Practical classes, 25 hours*
Assessment methods	*Written and oral.* *A mid-term written test and a final-term written test are foreseen.* *The mid-term written test will be devoted to the assessment of the level of achievement of LOs 2 and 3 (ability of students to solve numerical problems related to heat exchange).* *The final term written test will be devoted to the assessment of the level of achievement of LOs 2, 3 and, mainly, 4 and 5.*
Assessment criteria	*In the mid-term test students should demonstrate their ability to identify the heat transfer mode and to calculate heat exchange in a one - dimensional configuration and under assigned boundary conditions. The assessment will regard their capacity to correctly identify the heat transfer mode, to formulate the heat exchange equations and to solve them by using analytical methods.* *In the final term test students will be required to solve a problem related to a complex system (e.g. heat exchanger, finned surfaces, etc.). The problem will require also the interpretation of technical diagrams for the estimation of relevant parameters. The assessment will regard students' capacity to properly frame the problem, to identify the heat transfer mode and, in particular, to identify and correctly apply the best calculation process to the problem under consideration, to correctly interpret technical diagrams for the estimation of relevant parameters, and to obtain correct results. Finally, students' ability to participate in class discussions with teachers and colleagues will be assessed in practical classes.*

Assessment metrics	*Attribution of a final grade*
Criteria of attribution of the final grade	*The grade goes from 1 (minimum) up to 20 (maximum). The minimum threshold to pass is 7. To pass the exam students should obtain the minimum evaluation in all the assessments.* *The final grade will be determined according to the following rules:* - *Mid-term written test: 30%* - *Final term written test: 50%* - *Pratical work: 20%*
Preparatory course units	*N.A.*
Didactic material	*Yunus A. Cengel "Heat Transfer", MARUEEB Lecture Notes* *Battaglia J, Kusiak A, Puiggali J "Introduction aux TransfertsThermiques", Cours et exercices corrigés, DUNOD, Paris, 2010.* *Mebarek-Oudina F, "Echangeurs de Chaleur", Cours & Exercices corrigés, Editions Al-Djazair, 2017.*