Thermal Engineering

Academic Year: (2023 / 2024) **Review date: 16-01-2024**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: LAPORTE AZCUE, MARTA

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Calculus I
- Calculus II
- Physics I

SKILLS AND LEARNING OUTCOMES

CB1. Students have demonstrated possession and understanding of knowledge in an area of study that builds on the foundation of general secondary education, and is usually at a level that, while relying on advanced textbooks, also includes some aspects that involve knowledge from the cutting edge of their field of study
CB2. Students are able to apply their knowledge to their work or vocation in a professional manner and possess the competences usually demonstrated through the development and defence of arguments and problem solving within their field of study.
CG1. Ability to solve problems with initiative, decision-making, creativity, critical reasoning and to communicate and transmit knowledge, skills and abilities in the field of Industrial Engineering.
CG3. Ability to design a system, component or process in the field of Industrial Technologies to meet the required specifications
CG16. Knowledge of applied thermodynamics and heat transfer. Basic principles and their application to engineering problem solving.
ECRT1. Applied knowledge of thermal engineering.
RA1. Knowledge and understanding: Have basic knowledge and understanding of science, mathematics and engineering within the industrial field, as well as knowledge and understanding of Mechanics, Solid and Structural Mechanics, Thermal Engineering, Fluid Mechanics, Production Systems, Electronics and Automation, Industrial Organisation and Electrical Engineering.
RA2. Engineering Analysis: To be able to identify engineering problems within the industrial field, recognise specifications, establish different resolution methods and select the most appropriate one for their solution
RA5. Engineering Applications: To be able to apply their knowledge and understanding to solve problems and design devices or processes in the field of industrial engineering in accordance with criteria of cost, quality, safety, efficiency and respect for the environment.

OBJECTIVES

At the end of this course, students will be able to:
1. Know and understand about thermodynamics and heat transfer.
2. Apply their knowledge and understanding to identify, formulate and solve thermodynamic and heat transfer problems using the established methodology.
3. Design and carry out experiments, understand experimental data and obtain conclusions.
4. Have technical and laboratory knowledge.
5. Select and use adequate equipments, tools and methods.
6. Combine theory and practice to solve thermodynamic and heat transfer problems.
7. Understand the limitations of the techniques and methodology applied to thermodynamics and heat transfer.

DESCRIPTION OF CONTENTS: PROGRAMME

This is a basic course of Thermodynamics and an introduction to Heat Transfer.
The program can be divided in 2 main blocks, one about thermodynamics and another about heat transfer.

FIRST PART (THERMODYNAMICS AND CYCLES):
- Review of previous concepts of thermodynamics acquired by the student, thermodynamic properties,

T-s diagram of water, incompressible liquid and ideal gas models.
- Mass, energy and entropy balance for closed systems.
- Mass, energy and entropy balance for open systems.
- Equipments under steady state: nozzles, diffusers, pumps, compressors, turbines, open and closed heat exchangers, and valves.
- Thermal engines. Carnot cycle.
- Rankine cycle.
- Brayton cycle.
- Internal combustion engines.
- Inverse Carnot cycle. Refrigeration cycle.

SECOND PART (HEAT TRANSFER):
- Introduction to heat transfer: Fourier's law, Newton's law, Stefan-Boltzmann's law.
- One-dimensional steady state conduction with and without heat generation. Plane wall, cyclindrical and spherical geometries. Thermal resistances.
- Transient conduction.
- Fins: formulation, design and performance analysis. Finned surfaces.

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology includes:
(1) Lectures covering the main topics described within the course outline. To facilitate the sessions, the students will have available the lecture's notes as well as reference books to complete their learning.
(2) Case study and problem solving lectures, where some issues are addressed from a practical point of view.
(3) Exercises solved by the student to self-assess their knowledge and acquire the necessary skills.
(4) Group projects.

ASSESSMENT SYSTEM

- Labs (continuous assessment): 15%
- Midterm exam (continuous assessment): 25%
- Final Exam: 60% (25% thermodynamics + 35% heat transfer)

For those students who pass the partial exam (grade >= 5) the weight of each part will be the following:
- Labs (continuous assessment): 15%
- Midterm exam (continuous assessment): 50% (thermodynamics)
- Final Exam: 35% (heat transfer)

In any case, a minimum grade of 3.5 is required in the heat transfer part (final exam) to pass the course.

% end-of-term-examination:	60
% of continuous assessment (assigments, laboratory, practicals…):	40

BASIC BIBLIOGRAPHY

- F.P. Incropera and D.P. DeWitt Fundamentals of Heat and Mass Transfer, John Wiley & Sons. 6th edition, 2007
- M.J. Moran , H.N. Shapiro Fundamentals of Engineering Thermodynamics, John Wiley & Sons. 6th edition, 2010

ADDITIONAL BIBLIOGRAPHY

- A. Bejan Heat Transfer, John Willey & Sons, 1993
- J.P. Holman Heat Transfer, McGraw Hill, 1998
- F. Kreith y M.S. Bohn Principles of Heat Transfer, Thomson, 2002
- Y.A. Çengel Termodinámica, McGraw Hill, 1996.