Thermal Engineering

Academic Year: (2023 / 2024) **Review date: 11-09-2023**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: HERNANDEZ JIMENEZ, FERNANDO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- Calculus I
- Calculus II
- Physics I

In Aula Global there are two documents that present the concepts of these subjects that are essential to evolve properly in the present subject

OBJECTIVES

At the end of this course, students will be able to:

1. Know and understand about thermodynamics and heat transfer.
2. Be aware of the multidisciplinary context of thermal engineering .
3. Apply their knowledge and understanding to identify, formulate and solve thermodynamic and heat transfer problems using the established methodology.
4. Design and carry out experiments, understand experimental data and obtain conclusions.
5. Have technical and laboratory knowledge.
6. Select and use adequate equipments, tools and methods.
7. Combine theory and practice to solve thermodynamic and heat transfer problems.
8. 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 teaching methodology will include:
(1) Combined classes where the knowledge that students must acquire will be presented and problems will be solved in relation to the knowledge that will be presented. To facilitate their development, students will receive class notes (presentations, problem statements and exams from previous years) and will have basic reference texts that allow them to complete and delve into those topics in which they are most interested.
(2) Resolution of exercises by the student that will serve to self-assess their knowledge and acquire the necessary skills.
(3) Development of practical works. Preparation of reports presenting the results obtained in the laboratory and/or through computer software. The student's ability to present the results clearly and concisely, as well as their discussion, will be assessed.

ASSESSMENT SYSTEM

Continuous evaluation will be based on the following criteria:

- The knowledge acquired by the students will be evaluated by solving theoretical and practical exercises. Students should be able to reason and obtain their answers by applying the physical concepts and principles explained during the course.
- Group work and/or labs: students will be asked to carry out and deliver group work (for example, evaluation of an installation from a thermodynamic point of view, characterization of a heat sink, etc.).

EVALUATION CRITERIA

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

In any case, a minimum grade of 3.5 will be required in the heat transfer part 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

- Yunus Cengel and Michael Boles Thermodynamics: An Engineering Approach (8th Ed.), McGraw-Hill Education, 2014