Thermal Engineering

Academic Year: (2023 / 2024) **Review date: 18-09-2023**

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

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.
COCIN1. Ability to draft, sign and develop projects in the area of industrial engineering for construction, renovation, repair, preservation, demolition, manufacture, installation, assembly or operation of: structures, mechanical equipment, energy installations, electrical and electronic installations, industrial plants and installations and automation and manufacturing processes.
COCIN3. Knowledge of basic and technological subject areas that will capacitate them to acquire new methods and theories and endow them with the versatility to adapt to new situations.
COCIN4. Ability to resolve problems with initiative, decision-making, creativity, and critical reasoning skills and to communicate and transmit knowledge, skills and abilities in the Industrial Engineering field.
COCIN5. Knowledge to perform measurements, calculations, assessments, appraisals, surveys, studies, reports, work plans and other similar jobs.
CEP3. Ability to design and carry out experiments to analyze and interpret data obtained.
CER1. Knowledge of applied thermodynamics and heat transmission. Basic principles and application in resolving engineering problems.

By the end of this content area, students will be able to have:
RA1.1. Knowledge and understanding of thermodynamics and heat transfer fundamentals.
RA1.2. A systematic understanding of the key aspects and concepts of thermal engineering.
RA1.4. Awareness of the wider multidisciplinary context of engineering.
RA2.1. The ability to apply their knowledge and understanding to identify, formulate and solve problems of thermodynamics and heat transfer using established methods.
RA4.2. The ability to design and conduct appropriate experiments, interpret the data and draw conclusions.
RA4.3. Workshop and laboratory skills.
RA5.1. The ability to select and use appropriate equipment, tools and methods.
RA5.2. The ability to combine theory and practice to solve problems of thermodynamics and heat transfer.
RA5.3. An understanding of applicable techniques and methods in thermal engineering and of their limitations.

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