Thermal Engineering

Academic Year: (2023 / 2024) **Review date: 11/09/2023 10:08:15**

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

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.
CB3. Students have the ability to gather and interpret relevant data (usually within their field of study) in order to make judgements which include reflection on relevant social, scientific or ethical issues.
CB4. Students should be able to communicate information, ideas, problems and solutions to both specialist and non-specialist audiences.
CB5. Students will have developed the learning skills necessary to undertake further study with a high degree of autonomy.
CG2. Apply computational and experimental tools for analysis and quantification of energy engineering problems
CG4. Being able to do design, analysis, calculation, manufacture, test, verification, diagnosis and maintenance of energetic systems and devices.
CG10. Being able to work in a multi-lingual and multidisciplinary environment
CE1 Módulo CRI. Knowledge of the basic principles of thermal engineering and their application to the solution of problems in this field.
CT1. Ability to communicate knowledge orally as well as in writing to a specialized and non-specialized public.
CT2. Ability to establish good interpersonal communication and to work in multidisciplinary and international teams.
CT3. Ability to organize and plan work, making appropriate decisions based on available information, gathering and interpreting relevant data to make sound judgement within the study area.
CT4. Motivation and ability to commit to lifelong autonomous learning to enable graduates to adapt to any new situation.

By the end of this content area, students will be able to have:
RA1.1 knowledge and understanding of thermodynamics, heat transfer and fluid mechanics fundamentals.
RA1.2 a systematic understanding of the key aspects and concepts of thermal engineering and fluid mechanics.
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, heat transfer and fluid mechanics 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, heat transfer and fluid mechanics.
RA5.3 an understanding of applicable techniques and methods in thermal engineering and fluid mechanics 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

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

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.

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