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Thermal Engineering

Academic Year: (2019 / 2020) **Review date: 22-11-2019**

Department assigned to the subject: Department of Thermal and Fluids Engineering

Coordinating teacher: SERRANO GARCIA, DANIEL

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 1

STUDENTS ARE EXPECTED TO HAVE COMPLETED

- 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

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

The aim of this course is to understand the thermodynamic basic processes that determine the performance of elementary engineering devices (piston-cylinder assembly, valves, turbines, compressors, pumps, heat exchangers) and their integration in power or refrigeration cycles; and the basic principles related to heat transfer, present in any field of engineering (electronics, electrical and thermomechanical).

A the end of the course the student must be able to:
- Understand thermodynamic properties, diagrams and processes
- Identify the basic elements of a thermodynamic system, their function and working conditions such as temperature and pressure
- Apply the basic equations of the different components
- Analyze the operation of a system that integrates those basic devices
- Understand the different mechanisms involved in heat transfer
- Apply basic laws of heat transfer

As for the different competences acquired through the lectures, it is worth to distinguish between specific and general skills.

With regard to specific competences the student must be able to:
- Estimate efficiencies of simple engineering devices or systems
- Calculate working temperatures and pressures
- Estimate thermal and mechanical power demand/production in different processes or devices

The general skills trained during the course are:

- Problem solving methodology
- The identification of the relevant thermal information that characterize industrial installations
- Applying thermodynamics and heat transfer principles to solve problems
- Group work abilities (Overall collaborative work, and presentation)

After completing the course, the student should have:
- A critical attitude towards identifying and evaluating the operation of basic equipment of an installation
- A collaborative attitude that will allow obtaining information and knowledge from other agents to perform complex tasks

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. Besides, the thermodynamic section can be divided in 2 parts.

FIRST PART (THERMODYNAMIC): Review of previous concepts of thermodynamic acquired by the student, thermodynamic properties, T-s diagram of water, incompressible liquid model and ideal gas model, mass, energy and entropy balances in close systems.
Open systems. Mass, energy and entropy balances in open systems. Devices under steady state.

SECOND PART (THERMODYNAMIC): Power and refrigeration cycles. Ideal cycles. Real cycles (simplified). Carnot cycle. Rankine cycle. Brayton cycle. Internal combustion engines cycles. Refrigeration cycles.

THIRD PART (THERMODYNAMIC): Introduction to heat transfer. Mechanism of heat transfer. Fourier¿s law. Cooling law of Newton. Stefan-Boltzmann¿s law. One-dimensional steady state conduction. Fins: formulation, design and analysis of efficiency and effectiveness. Transient conduction.

EVALUATION
The evaluation will be based on the following criteria:
- Labs (15%)
- Partial test (25%)
- Final exam (60%)

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

The continuous assesment will be evaluated under the following criteria:

PROBLEMS AND TESTS SOLUTIONS. MID-TERM EXAM
- Individual evaluation with tests and exercises.
- Workgroup projects or/and laboratory work.

FINAL EXAM
The students' knowledge will be evaluated.

Participation with positive contributions during the classes will be very welcomed and taken into account.

% 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