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Applied thermal engineering

Academic Year: (2022 / 2023) **Review date: 13-09-2022**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: GARCIA GUTIERREZ, LUIS MIGUEL

Type: Compulsory ECTS Credits : 3.0

Year : 4 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Thermal Engineering (2nd year)
Heat Transfer (3rd year)

OBJECTIVES

The fundamental objective of this course is to use the fundamental concepts of thermodynamics and heat transfer, acquired in the previous courses, in the industrial applications of cold / heat and power generation. To achieve this goal, the student must acquire a series of knowledge, skills and attitudes.

With regard to knowledge, at the end of the course the student will be able to:

- Analyze and solve advanced thermal engineering applications of cold / heat and power generation from a global perspective.

- Analyze and solve the main elements that conform the thermodynamic cycles.

- Design optimal thermodynamic cycles and their elements.

In terms of capabilities, these can be classified into two groups: specific capacities and generic skills.

For the specific abilities, at the end of the course the student will be able to:

- Determine the relevant parameters of thermal engineering applications, such as power, efficiency, etc.

- Size equipment and facilities that conform the thermodynamic refrigeration and power generation cycles.

- Dimension and optimize thermal applications based on thermodynamic cycles.

Regarding the general skills, during the course they will work:

- The ability to solve thermal engineering problems.

- The ability to search, communicate and discriminate which is the relevant information to characterize an installation from the thermodynamic and thermotechnical point of view.

- The ability to apply knowledge of heat transfer and fundamental thermodynamics in the resolution of engineering problems.

- The ability to work in teams and distribute the workload to face complex problems.

Regarding attitudes, the student, after completing the course, should have:

- A critical attitude to identify and evaluate the activities and operation of industrial refrigeration and power generation facilities (power plants).

- Evaluate and design the activities and operation of the equipment that conform refrigeration and power generation facilities using a critical attitude.

- A collaboration attitude that allows the student to search for information and related topics necessary to perform complex tasks

DESCRIPTION OF CONTENTS: PROGRAMME

The course of Applications of Thermal Engineering will address aspects of direct application within the field of thermal engineering. In particular, real applications of gas cycles, steam cycles, combined cycles, heat recovery generators, refrigeration cycles, exergy introduction and new trends in power generation cycles will be described. The subject is divided into 6 clearly differentiated parts. The knowledge acquired in each of the parts is useful in the subsequent parts:

PART 1: Gas cycles:
- Regeneration.
- Afterburning.
- Intercooling.

PART 2: Steam cycles:
- Regeneration.
- Reheating.

PART 3: Combined cycles:
- Operating principle.
- Main elements.
- Heat Recovery Steam Generator (HRSG) design.
- Several pressure levels.

PART 4: Refrigeration cycles:
- Cascade cycles.
- Multistage compression.

PART 5: Exergetic analysis:
- Introduction to exergy
- Application to power generation cycles.

PART 6: New trends on power generation plants:
- Use of fuels.
- Supercritical and ultracritical cycles.
- Optimization of design parameters.

Each part of the course consists of at least one theoretical session and one practical session in which exercises applied on the board will be solved. Additionally, two practical sessions will be held in the computer classroom. In these sessions, computer tools will be used to solve complex problems related to the course. The students will solve a practical case study in which they will apply the knowledge, both theoretical and practical, they have achieved up to that moment.

The theoretical class sessions will be complemented by examples of real power plants, studying each of its components and analyzing their differences according to the improvements applied on the cycle and depending on the type of energy used for the operation of the plant.

The evaluation of the knowledge acquired during the course will be carried out by means of a final examination and the continuous evaluation. The continuous evaluation will independently assess the deliverable case study and the part related to hands-on sessions in the computer classroom that will be assessed by means of deliverables after session. The student participation throughout the course will also be taken into account during the continuous assessment through small activities prior to some of the practical sessions.

LEARNING ACTIVITIES AND METHODOLOGY

- Lectures on theory and applications.
- Solving problems individually and in groups.
- Performing tasks individually and in groups.
- Lab (computer rooms).
- Case study

All of the activities are aimed at obtaining general and specific skills listed above.

ASSESSMENT SYSTEM

The evaluation of the knowledge acquired during the course will be carried out by means of a final examination (40%).

The continuous evaluation will independently assess the deliverable case study (30%), the part related to hands-on sessions in the computer classroom (25%) and quizs related to practical sessions.

A minimum mark in the final exam of 40% of its total is required to to pass the course.

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

BASIC BIBLIOGRAPHY

- Incropera F.P., DeWitt D.P., Bergman T.L., Lavine A.S. Fundamentals of heat and mass transfer, John Wiley & Sons, 2007
- Moran M.J, Shapiro H.N. Fundamentals of engineering thermodynamics : SI version , John Wiley & Sons, 2010
- Thomas C. Elliot Standard Handbook of Power Plant Engineering, McGraw-Hill, 1998

ADDITIONAL BIBLIOGRAPHY

- Dipak Sarkar Thermal Power Plant, Elsevier, 2015
- J.H. Horlock Advanced Gas Turbine Cycles, Pergamon, 2003
- J.H. Horlock Combined Power Plants, Pergamon Press, 2002