Heat power plants

Academic Year: (2022 / 2023) **Review date: 13-05-2022**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: HERNANDEZ JIMENEZ, FERNANDO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Thermal Engineering

OBJECTIVES

The goal of this course is to show and explain the thermodynamic cycles used in thermal power plants, in addition to the linked technology. The final goal is to acquire the capacities to analyze the behavior of thermal power plants. In order to reach this goal the student has to acquire knowledge, competences and attitudes.

With regard to the knowledge, at the end of the course the student must be able to:
-Understand the parameters that govern the forced convection heat transfer (internal flow and external flow).
-Evaluate the performance of heat exchangers.
- Identify the basic components of a thermal power plant, their function and their working conditions.
- Know the processes and parameters that define the power plants, and evaluate their performance.
- Know the state of the art technology of each case.
- Analyze the energy saving possibilities and the environmental impact of each power plant, especially in terms of global warming potential of their pollutants emissions.
With regard to the competences, they can be classified into two groups: the specific competences on one hand and general competences or skills on the other hand.
With regard to the competences, at the end of the course the student must be able to:
- Set out the thermodynamic design of a power plant.
- Identify and distinguish devices (turbomachines, boilers, combustion chambers) and power plant subsystems.
- Know the application field of every thermal power plant.
- Evaluate environmental consequences of the use of each power generating technology.

With regard to the general competences, during the course the skills develop are:
- The capability of solving problems.
- The capability of searching, communicating and distinguishing the relevant information to characterize a thermal power plant.
- The capability of working in teams and to share the work in order to face complex problems.
With regard the attitudes the student should have after the course:
-Critical attitude with respect the identification process and evaluation of the performances of elemental devices of the power plant installation.
-Cooperation attitude in order to get information from other agents and knowledge to accomplish complex tasks.
This is a course that involves a fundamental basis and a technological basis.

DESCRIPTION OF CONTENTS: PROGRAMME

The program is divided in the following parts:
INTRODUCTION:
- Generalities and classification of power plants (vapor cycle, gas cycle, reciprocating engines: Diesel, Otto and dual cycles). Fuel types (solids, liquids and gases). Review of heat transfer modes.
PART I
Forced convection heat transfer:
-Internal flow convection.
-External flow convection.
Heat exchangers:
PART II

(Power plants based on Brayton (gas) and Rankine (vapor) cycles):
- Simple Brayton and Rankine power cycles and improved cycles.
  -Simple Brayton, inter-cooling, reheating, regenerative, complex cycles, closed cycles. Efficiency and optimization.
  -Simple Rankine, reheating, regeneration (vapor extraction and drenage). Complete cycles. Efficiency and optimization.. Examples: Organic Rankine Cycles, Geothermal power plants.
- Operative fundamentals and turbomachinery architecture.
  - Kinematics and pressure variation in turbomachinery. Velocities composition.
  - Operation curves in incompressible and compressible flow.
-Fundamentals of boilers, combustion chambers
  - Water-tube boiler.
  - Burners and combustion chambers.
- Operation and architecture of other devices.
  -Dearetors and feedheaters.
  -Condensers
  -Refrigeration towers
- Combined cycle
  -Operation and design parameters.
  - HRSG, state of the art: reheating and pressure levels. Design parameters and operation performances.
- Cogeneration and polygeneration
  -Operation and design parameters.
  -Reciprocating engines (Otto, Diesel and Dual cycles) and Stirling engines in polygeneration.
  -Gas turbines in polygeneration.

LEARNING ACTIVITIES AND METHODOLOGY

The educational methodology includes:
1) Lectures covering the main topics of the course. In order to facilitate the learning process the student will receive support material and information to let them complete and focus on the relevant topics or interesting topics for them.
2) Resolution of problems, related to the knowledge that must be acquired and above all related to the specific competences the student must develop.
3) Resolution of exercises that will allow the student to consolidate the knowledge and contrast the results with the reality. This will develop the capacity of self-evaluation and the students will acquire skills and develop technical creativity.
4) Reports elaboration.

ASSESSMENT SYSTEM

This subject is in the process of extinction and will not have teaching. Consequently, the student will have the right to an exam or final test with the value of 100% of the total grade on the exam dates established in the academic calendar for the 2022-2023 academic year.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- F. P. Incropera, D. P. DeWitt Fundamentals of heat and mass transfer, Pearson.
- M.J. Moran, H.N. Shapiro Fundamentals of Engineering Thermodynamics, Wiley.