Power plants and heat engines

Academic Year: (2018 / 2019) **Review date: 22/03/2017 11:57:08**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: SANCHEZ DELGADO, SERGIO

Type: Compulsory ECTS Credits : 6.0

Year : 3 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Thermal Engineering

OBJECTIVES

The aim of this course is to understand the thermodynamic cycles and technology used in heat engines and power plants. This includes the capability of analyzing the behaviour of thermal engines, turbomachinery, boilers, burners and combustion chambers as components of these systems.
A the end of the course the student must be able to:
- Identify the basic elements of a power plant, their functionality and working conditions.
- Understand the parameters and processes involved in these installations and evaluate their performance
- Understand the technology corresponding to each case.
- Analyze the energy saving possibilities and the environmental impact for each heat engine and power plant described in the course.

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:
- Define the thermodynamic layout and magnitudes of a power plant.
- Identify the different types of reciprocating engines and power plant components (turbomachinery, boilers, combustion chambers, etc.) and subsystems.
- Establish the applicability frame of the different heat engines.
- Evaluate the environmental impact of the use of different technologies for power generation.

The general skills trained during the course are:
- Problem solving methodology.
- The identification of the relevant information that characterize power generation installations.
- Group work abilities to face complex engineering subjects

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.

DESCRIPTION OF CONTENTS: PROGRAMME

This course includes fundamental and technological knowledge.
The program is divided into the following sections:
INTRODUCTION:
- General considerations and types of power plant. Pollutants emissions.
SECTION I (Brayton and Rankine cycles in power plants)
- Brayton and Rankine cycles for power generation, improved cycles.
  -Brayton, inter-cooling, reheating, regeneration, ciclos complex and closed cycles.

-Rankine, reheating, regeneration (steam extractions and drains). Complex cycles.
- Turbomachinery: working fundamentals and characteristic diagrams.
-Kinematics and pressure variation. Velocity triangle.
-Gas and steam turbines architecture.
-Dimentional analysis and operating diagram for incompressible and compressible flow.
-Cavitation.
- Boiler, combustion chamber and nuclear reactor fundamentals.
-Cast iron boilers.
-Steel boilers, constitutive elements. Accidents
-Combustion chamber and flame stabilization.
- Other component fundamentals
-Deaerator and feed water.
-Condensers
-Cooling towers
SECTION II
- Environmental issues
- Plantas nucleares
-Constitutive elements
-Types of plants
-Nuclear fuel cycles
-Accidents
- Combined cycle
-Fundamentals, design and operative parameters.
-State of the art. HRSG, pressure levels and reheating.
-Clean coal technologies. GICC.
- Cogeneration (CHP) and polygeneration with reciprocating engines and
-Fundamentals, design and operative parameters.
-With reciprocating engines
-With gas turbines
- Working fundamentals and maintenance in power plants
-Load and speed control
-Desundary control loops.

LEARNING ACTIVITIES AND METHODOLOGY

The learning methodology includes:
- Lectures covering the main topics described within the course outline.
- Case study and problem solving lectures, where some issues are addressed from a practical point of view.
- Group projects.

ASSESSMENT SYSTEM

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

- Class assignments: within the classes, theoretical and applied exercises will be proposed to revise the main topics covered during the session. In this frame and that of the lectures, positive contribution given by the student will be considered.
- Projects: both individual projects and workgroup projects will be performed.
- Final Exam: where the acquired knowledge will be evaluated.

BASIC BIBLIOGRAPHY

- Horlock J.H. Combined power plants, Pergamon Press, 1992

- Lecuona A.; Nogueira J.I. TURBOMAQUINAS, PROCESOS, ANALISIS Y TECNOLOGIA, Ariel, 2000

- Legrand M., Ventas R., Rodríguez P.A. Ingeniería Térmica: Principios de termodinámica técnica y transferencia de calor, Garceta, 2013

- Moran M.J., Shapiro H.N. Fundamentos de termodinámica técnica, Reverte, 2004

ADDITIONAL BIBLIOGRAPHY

- Lecuona A., Nogueira J.I. TURBOMAQUINAS, PROCESOS, ANALISIS Y TECNOLOGIA, Ariel, 2000