Internal combustion engines

Academic Year: (2020 / 2021) **Review date: 10-07-2020**

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

Coordinating teacher: ACOSTA IBORRA, ANTONIO

Type: Electives ECTS Credits : 3.0

Year : 4 Semester :

STUDENTS ARE EXPECTED TO HAVE COMPLETED

Thermal Engineering (2nd course)
Thermal Power Plants (3th course)

COMPETENCES AND SKILLS THAT WILL BE ACQUIRED AND LEARNING RESULTS.

By the end of this course, students will be able to have:
1.- A systematic understanding of the key aspects and concepts of internal combustion engines comprising both the reciprocating internal combustion engines and the gas turbines.
2.- A coherent knowledge of main elements and processes of internal combustion engines according to the current and forthcoming technologies.
3.- The ability to apply their knowledge and understanding to identify, formulate and solve problems of performance, fuel consumption and emissions of an engine by means of methods established in thermal engineering.
4.- The ability to select and apply relevant analytic and modelling methods in thermal engineering to determine the thermal and fluid dynamic behaviour of the stages of the internal combustion engine cycle as well as the cycle trends upon changes and ways to control it.
5.- The ability to apply their knowledge and understanding to develop and realise designs of systems and facilities that include internal combustion engines to meet defined and specified requirements.
6.- An understanding of design methodologies in thermal engineering, and an ability to use them to evaluate the implications that the design and operation conditions have in the performance, interaction with the surroundings and reliability of the internal combustion engines.
7.- The ability to select and use appropriate equipment, tools and methods to solve problems in which the performance and operation of the elements and devices of an internal combustion engine are evaluated.
8.- The ability to combine theory and practice of thermodynamics, combustion, fluids flow, heat transfer and mechanics theories to solve problems of internal combustion engines.
9.- An understanding of applicable techniques and methods in thermal engineering and of their limitations in characterizing and designing internal combustion engines.

DESCRIPTION OF CONTENTS: PROGRAMME

1.- Internal combustion engines. Types and applications.Basic processes. Performance and control parameters.
2.1.- Reciprocating internal combustion engines: Gas exchange process.
2.2.- Reciprocating internal combustion engines: Gas exchange process similitude.
2.3.- Reciprocating internal combustion engines: Exercises of gas exchange process applications.
2.4.- Reciprocating internal combustion engines: Combustion in spark-ignition engines.
2.5.- Reciprocating internal combustion engines: Combustion in compression-ignition engines.
2.6.- Reciprocating internal combustion engines: Engine performances as a function of ambient operating conditions. Engine operating characteristics. Normalizing performances methods.
2.7.- Reciprocating internal combustion engines: Applied exercises.
3.1.- Gas turbines: Types and applications. Real cycles of GTs. Components efficencies.
3.2.- Gas turbines: GTs operating modes. Criteria for optimizing efficiency and delivered power.
3.3.- Gas turbines: GTs performances vs ambient operating conditions. GT operating characteristics. Normalizing performances methods.
3.4.- Gas turbines: Applied exercises.
4.- Turbocharging: Energy charecterizing of exhaust gases. Technology of turbocharging.
5.- Internal combustion engines and GT pollutants formation and control.

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 students will receive support material and information to let them complete and focus on the degree's relevant topics or the 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 applied 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 and presentation.
5) Sharing of answers and group corrections, which should be used to consolidate knowledge and develop the ability to analyze and transmit the relevant information to solve problems. Besides, sharing of answers will favor the exchange of constructive critical opinions both amongst the students and between the students and the instructor.

ASSESSMENT SYSTEM

The continuous assessment is based on the following criteria:
-Class participation: concise answers, connected to the ideas exposed during the course and providing added value, will be positively viewed. For this purpose, the professor will provide questions, debates, theoretical and practical exercises, etc.
- Resolution of problems and work elaboration through two kinds of activities:
  · Individually solved problems.
  · Teamworks in which the students will be asked to elaborate and present teamworks (for example, the assessment of an engine from the thermal and energy point of view).
- Midterm exam comprising one part of the course.
- Laboratory sessions: the students will be asked to answer questions related with the activity they have done in these sessions.

The end-of-term-examination (final exam) will evaluate the knowledge and skills of the student acquired in the course.

To pass the course, the following two requirements need to be met:
1) The mark of the final exam should be equal to or greater than 2.0 over 10.
2) The overall mark of the course should be equal to or greater than 5.0 over 10.

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

BASIC BIBLIOGRAPHY

- Heywood, J.B. Internal combustion engine fundamentals, McGraw-Hill , 1988

- Payri, F. y Desantes, J.M: Motores de combustión interna alternativos, Universidad Politécnica de Valencia, 2011

- Saravanamutto, H.I.H.; Rogers, G.F.C.; Cohen, H.; Straznicky, P.V.; Nix, A.C. Gas turbine Theory, 7th Edition, Pearson, 2017