Thermal Engineering

Academic Year: (2023 / 2024) **Review date: 09-05-2023**

Department assigned to the subject: Thermal and Fluids Engineering Department

Coordinating teacher: CANO PLEITE, EDUARDO

Type: Compulsory ECTS Credits : 6.0

Year : 2 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Physics II

OBJECTIVES

1) To provide students with well-founded knowledge of several thermodynamic processes in engineering.

2) To present from a critical perspective the principal assumptions and simplifications that lead to preliminary analyses and designs in thermal engineering.

3) To capacitate students with skills in evaluating heat transfer by conduction, convection and radiation, and to use all these abilities in the design of heat transfer equipment.

4) To be capable of characterising propulsive forces and how well the power produced by an engine is utilized in propelling an aerospace vehicle.

5) To be able to discriminate the principal parameters controlling gas turbine and internal combustion engines, and their integration in aerospace propulsion systems.

DESCRIPTION OF CONTENTS: PROGRAMME

Part-1: Fundamentals of engineering thermodynamics.

1.- Review of thermodynamics and closed system analysis.

2.- Thermodynamic properties.

3.- Control volume analysis.

4.- Thermodynamic analysis of internal combustion engines: Otto, Diesel and Dual cycles.

5.- Thermodynamic analysis of gas turbines: Brayton cycle.

6.- Psychrometrics.

Part-2: Introduction to aerospace propulsion systems.

7.- Introduction to propulsion: propulsion parameters, main propulsion systems and cycles.

Part-3: Introduction to heat transfer engineering.

8.- Introduction to heat transfer.

9.- One-dimensional steady state heat transfer.

10.- Extended surfaces (fins).

11.- Transient conduction of heat.

12.- Forced external flow convection heat transfer.

13.- Forced internal flow convection heat transfer.

LEARNING ACTIVITIES AND METHODOLOGY

Learning activities in the course are based on lectures attendance, self study, problem solution, and laboratory sessions.

1) Lectures: one session per week. The instructor will provide in advance the electronic materials used in class, comprising presentation files, problem sets, property tables, bibliography, and other needed documentation. To optimise the class learning process, it is recommended to read the materials prior to each lecture.
2) Practical Seminars: one session per week attended by small groups of students. These seminars are tutorial sessions specially focused on solving problems and linking the theory with the practice. Students' questions concerning the problems will be answered by the instructor.
3) Practical laboratory work. There are four laboratory sessions aimed to make explicit what has been taught during the theoretical lectures. It is compulsory to read the laboratory guidelines & instructions before attending the sessions. After each session, a written report analysing the obtained results should be delivered to the laboratory instructor.

ASSESSMENT SYSTEM

OPTION A (partial mark>=5):
- Laboratory practices (continuous evaluation): 15%
- Partial exam (continuous assessment): 50% (thermodynamics and cycles)
- Final Exam: 35% (heat transfer)

OPTION B (partial mark <5):
- Laboratory practices (continuous evaluation): 15%
- Partial exam (continuous evaluation): 25%
- Final Exam: 60% (25% thermodynamics and cycles +35% heat transfer)

In any case, a minimum grade of 3.5 will be required in the heat transfer part to pass the course.

In the extraordinary call (June), the final exam can cover 100% of the final mark.

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

BASIC BIBLIOGRAPHY

- F.P. Incropera & D.P. De Witt Fundamentals of Heat and Mass Transfer, John Wiley & Sons, 2007
- G.C. Oates Aerothermodynamics of Gas turbine and Rocket Propulsion, AIAA Education Series, 1997
- M.J. Moran & H.N. Shapiro Fundamentals of Engineering Thermodynamics (S.I. version), John Wiley & Sons, 2010

ADDITIONAL BIBLIOGRAPHY

- M. J. Moran, H. N. Shapiro, B. R. Munson, D. P. DeWitt Introduction to Thermal Systems Engineering: Thermodynamics, Fluid Mechanics and Heat Transfer, Wiley, 2003