
Academic Year: (2023 / 2024)**Review date: 17-05-2022**

Department assigned to the subject: Aerospace Engineering Department**Coordinating teacher: AHEDO GALILEA, EDUARDO ANTONIO****Type: Compulsory ECTS Credits : 3.0****Year : 1 Semester : 1**

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Complements of Aerospace Engineering

OBJECTIVES

Basic competences

CB6 To possess and understand knowledge that provides a basis or opportunity to be original in the development and / or application of ideas, often in a research context

CB7 Students must know how to apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study

CB8 Students must be able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and judgments

CB9 Students must know how to communicate their conclusions and the knowledge and ultimate reasons that sustain them to specialized and non-specialized audiences in a clear and unambiguous way

CB10 Students must have the learning skills allowing them to continue studying in a way that will be largely self-directed or autonomous.

General competences

CG1 Capacity for the formulation, critical verification and defense of hypotheses, as well as the design of experimental tests for verification.

CG2 Ability to make value judgments and prioritize in making conflicting decisions using systemic thinking.

CG4 Ability to work in multidisciplinary teams in a cooperative way to complete work tasks

CG5 Ability to handle the English, technical and colloquial language.

Specific competences

CE3 Ability to develop a complete system that meets the design specifications and the expectations of the interested parties. This includes the production of products; acquire, reuse or code products; integrate products in top-level assemblies; verify products against design specifications; validate the products against the expectations of the interested parties; and the transition of products to the next level of the system.

CE9 Ability to understand and apply the knowledge, methods and tools of space engineering to the analysis and design of the propulsion subsystem of space vehicles.

DESCRIPTION OF CONTENTS: PROGRAMME

1. IN-SPACE PROPULSION

Propulsion figures of merit: thrust, specific impulse, efficiencies.

Propulsive requirements in space missions. Rocket equation.

2. CHEMICAL PROPULSION IN SPACE

Figures of merit in chemical rockets (nozzles): thrust coefficient, characteristic velocity, etc.

Monopropellant rockets: cold gas and hydrazine-based rockets.

Bipropellant rockets: analysis of fuels and oxidizers. Review of thermochemistry.

3. PROPELLANT MANAGEMENT UNIT

Introduction and review of the propellant management unit (PMU).

Valves, pressure regulators and tanks.

Tank sizing: pressurizer gas, propellant, and supercritical fluids.

4. ELECTRIC PROPULSION: MISSIONS

The family of plasma thrusters

Plasma production and acceleration mechanisms

Optimum specific impulse

Missions with electric propulsion

5. ELECTRIC PROPULSION: PHYSICS

Operation principles of Ion and Hall Thrusters.

Maxwell and Fluid equations.

Quasineutrality. Collisional processes.

Dynamics of magnetized populations.

6. ION GRIDDED THRUSTERS

Elements and electrical configuration.

Global model of the discharge chamber.

Grid model and expansion of the plasma jet.

Performance laws.

The hollow cathode.

LEARNING ACTIVITIES AND METHODOLOGY

AF1 Theoretical class

AF2 Practical classes

AF3 Practices in computer classroom

AF4 Laboratory practices

AF6 Group work

AF7 Individual student work

AF8 Evaluation activities

Code

activity	Nº Total hours	Nº HoursPresencial	% Student's presence
AF1	103	103	100
AF2	45	45	100
AF3	28	28	100
AF4	14	14	100
AF6	67	0	0
AF7	400	0	0
AF8	24	24	100
TOTAL SUBJECT	682	215	32

Teaching methodologies that will be used in this subject

MD1 Exhibitions in the teacher's class with support of computer and audiovisual media, in which the main concepts of the subject are developed and the bibliography is provided to complement the students' learning.

MD3 Resolution of practical cases, problems, etc. raised by the teacher individually or in groups

MD5 Preparation of papers and reports individually or in groups

ASSESSMENT SYSTEM

% end-of-term-examination: 60

% of continuous assessment (assignments, laboratory, practicals...): 40

EVALUATION SYSTEMS:

ASSESSMENT SYSTEMS OF THE STUDY PLAN REFERRED TO SUBJECTS

SE2 Individual or group work carried out during the course

SE3 Final exam

System of Evaluation	Minimum weight (%)	Maximum weight (%)
SE2	40%	100%
SE3	0%	60%

In order to pass the subject in the ordinary call, two requirements need to be met:

- 1) to have a MINIMUM mark of 4.0 over 10 in the end-of-term exam;
- 2) to have a minimum overall mark of 5.0 over 10 (weighing 60% the end-of-term exam mark and 40% the mark of the continuous evaluation).

BASIC BIBLIOGRAPHY

- D. GOEBEL, I. KATZ FUNDAMENTALS OF ELECTRIC PROPULSION, WILEY , 2008
- G. Sutton and O. Biblarz, Rocket Propulsion Elements, , Wiley, , 2010.

ADDITIONAL BIBLIOGRAPHY

- M. J. L. Turner Rocket and Spacecraft Propulsion, Springer, 2006
- R. JAHN PHYSICS OF ELECTRIC PROPULSION, DOVER, 2006