Space Environment

Academic Year: (2022 / 2023) **Review date: 10-04-2022**

Department assigned to the subject: Department of Bioengineering and Aerospace Engineering

Coordinating teacher: SANCHEZ ARRIAGA, GONZALO

Type: Compulsory ECTS Credits : 3.0

Year : 1 Semester : 1

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

General Physics Courses

OBJECTIVES

Get knowledge and understaing of the most important aspects of the space environment, how they should be taken into account during the design and manufacturing of space products, and how they can be used to achieve the goals of missions in an efficient manner. This introductory course covers a broad range of topics that include the Solar System, the Sun, the Earth's magnetosphere, magnetic and gravitational fields, the spacecraft-plasma interaction, the propagation of linear waves in plasmas, the space debris, and the effects of the space environment on materials and humans. The student will learn in the labs how to use and develop software with models to get useful information about the space environment (radiation, ionospheric plasma, gravitational and magnetic fields, space debris, etc.).

DESCRIPTION OF CONTENTS: PROGRAMME

1 Introduction to space environment

2 The Solar System
- 2.1 Introduction to stellar physics
- 2.2 The Sun
- 2.3 The planets of the solar System
- 2.3 The interplanetary medium and the solar wind

3 The Earth's magnetosphere
- 3.1 Regions.
- 3.2 Van Allen belts
- 3.3 Cosmic rays
- 3.4 Solar particle events

4 The near Earth environment I
- 4.1 Gravitational field
- 4.2 Magnetic field
- 4.3 Electric field

5 The near Earth environment II
- 5.1 The neutral atmosphere
- 5.2 The ionosphere

6 Plasma interactions I: spacecraft charging
- 6.1 Debye length
- 6.2. Models
- 6.3 Sputtering and electrical arcs
- 6.4 Mitigatión means

7 Plasma Interactions II: plasma waves
- 7.1 Linear waves in magnetized plasmas
- 7.2 Effects on spacecraft communications

8 Meteoroids and space debris
- 8.1 Models

8.2 Current state of the space debris population
8.3 International guidelines and initiatives.
8.4 Mitigation means.

9 Effects on materials
9.1 Outgassing
9.2 Radiative effects
9.3 Thermal Effects
9.3 Mitigation means

10 Effects on humans
10.1 Microgravity
10.2 Radiation
10.3 Environmental control and life support subsystem

LEARNING ACTIVITIES AND METHODOLOGY

AF1 Theoretical class
AF2 Practical classes
AF3 Practices in computer classroom
AF6 Group work
AF7 Individual student work
AF8 Evaluation activities

METHOLOGY

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

EVALUATION SYSTEMS:

Final exam (60%)
Practical problems with evaluation of reports (40%)
Required minimum mark on final exam: 4/10

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

BASIC BIBLIOGRAPHY

- A. C. Tribble The Space Environment: Implications for Spacecraft Design, Princeton University Press, 2003

- George Khazanov Space Weather Fundamentals, CRC Press, 2019

- V. L. Pisacane The Space Environment and Its Effects on Space Systems, American Institute of Aeronautics and Astronautics, 2016

ADDITIONAL BIBLIOGRAPHY

- D. A. Vallado Fundamentals of Astrodynamics and Applications, Space Technology Library, 2001

- European Cooperation for Space Standardization Space Engineering: Space Environment, ECSS-E10-04C, 2008

- O. Montenbruck and E. Gill Satellite Orbits: Models, Methods, Applications, Springer, 2001

- W. Baumjohann and R. A Treumann Basic Space Plasma Physics, Imperial College Press, 1996