Space systems design

Academic Year: (2021 / 2022) **Review date: 09-06-2021**

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

Coordinating teacher: CICHOCKI , FILIPPO

Type: Compulsory ECTS Credits : 6.0

Year : 1 Semester : 2

REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

- BSc Aerospace Engineering courses related to: Classical mechanics, orbital dynamics, electromagnetism, thermodynamics, heat transfer, electric power, structural calculus, rocket motors, control theory, computer programming

OBJECTIVES

At the end of the course, the student shall be capable of understanding and mastering:

- The design and analysis of space systems and space missions
- The unique aspects of the space environment and the requirements it imposes on a Space System / Space Mission
- The types of Space system, Space Mission phases and procedures, and the design drivers behind each of them
- The different segments that compose a space system
- The different subsystems of the space segment in a space mission, their operation and sizing
- The space propulsion systems, launchers, and their operation
- Ground segment requirements and operation
- The certification requirements for space vehicles, and judge their acceptance levels

Link to document

DESCRIPTION OF CONTENTS: PROGRAMME

- Introduction to Space Systems and Missions, the different segments (space, ground and launch) and subsystems.
- The space environment.
- Space Systems Engineering.
- Mission analysis: orbital maneuvers, groundtracks, mission examples in LEO, MEO, GEO and interplanetary missions
- The space segment subsystems:
  - o Space propulsion
  - o Attitude and Orbit Control (AOCS)
  - o Translational GNC
  - o Communications and data handling (onboard computer)
  - o Telemetry, tracking and telecommand
  - o Electric power
  - o Structures and mechanisms. S/C configuration
  - o Thermal control
- Launchers and access to space
- Manufacturing, assembly; certification, testing and QA
- Ground segment and operations
- End of life considerations; space debris, space law

LEARNING ACTIVITIES AND METHODOLOGY

The course has 29 classroom sessions (100 minutes) divided as follows:

- Theory sessions on the different course topics (21 sessions)
- Lab/Computer room sessions with practical exercises/design examples on the different subsystems (6 sessions). During one of these sessions, a homework is also presented
- Continuous evaluation sessions with quiz (2 sessions)

The course has an estimated student workload of 150 h (6 ECTS), including personal work.

Communication with the students will be done through aulaglobal: aulaglobal.uc3m.es. Students can ask for tutorial sessions with the faculty on the hours advertised there.

ASSESSMENT SYSTEM

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

1) To have a MINIMUM grade of 4.0/10 in the end-of-term exam.
2) To have a MINIMUM overall grade of 5.0/10 (weighting 60% the end-of-term exam grade and 40% the continuous evaluation grade).

Continuous evaluation (40%) is based on both quizzes and homework organized during the course

For the extraordinary evaluation, the grade will be the best grade of the two:
1) Grade of the extraordinary exam.
2) Grade of the extraordinary exam (60%) plus continuous evaluation grade (40%).
It is still necessary to reach a MINIMUM of 4/10 in the exam and 5/10 in the global grade to pass the course.

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

BASIC BIBLIOGRAPHY

- J.R. Wertz Space Mission Engineering: The New SMAD, Space Technology Library, 2011
- P. Fortescue Spacecraft systems engineering, Wiley, 2011

ADDITIONAL BIBLIOGRAPHY

- D.A. Vallado Fundamentals of Astrodynamics and Applications, Microcosm Press, 2013
- G.P. Sutton Rocket Propulsion Elements, Wiley, 2010
- M.D Griffin Space Vehicle Design, AIAA Education Series, 2004
- V.L. Pisacane The Space Environment and Its Effects on Space Systems, AIAA Education Series, 2008
- V.L. Pisacane Fundamentals of Space Systems, Oxford University Press, 2005