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**Academic Year: ( 2024 / 2025 )****Review date: 26-04-2024**

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**Department assigned to the subject: Aerospace Engineering Department****Coordinating teacher: NAVARRO CAVALLE, JAUME****Type: Compulsory ECTS Credits : 6.0****Year : 1 Semester : 2**

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## 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

The student shall acquire a good knowledge of the design and sizing of the different subsystems needed to build up a spacecraft for Space missions. The student shall understand the links between all the subsystems involved and how the characteristics of the Space environment impact on their design. Also, having a clear understanding of how the mission requirements specs drive the design process.

Furthermore, the student shall understand the processes/tasks to be completed within the different mission phases, as well as the different mission segments that supports any Space mission. This includes the understanding of the certification and validation protocols specifically defined for Space missions.

## 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:

- AF1 (MD1/MD2). Theory sessions on the different course topics (21 sessions)
- AF2/AF3/AF4/AF5 (MD3/MD4/MD5). 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.

AF6. 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

<b>% end-of-term-examination:</b>	60
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	40

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.

#### 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

#### BASIC ELECTRONIC RESOURCES

- European Space Agency and other Institutions . European Cooperation for Space Standardization: <https://ecss.nl/>