AEROSPACE ENGINEERING (LM52)

(Brindisi - Università degli Studi)

Teaching SPACE MISSION PROJECT AND SYSTEMS (MOD.2) C.I.

GenCod A006606

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Teaching in italian SPACE MISSION PROJECT AND SYSTEMS (MOD.2) C.I.

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SSD code ING-IND/05

Reference course AEROSPACE ENGINEERING

Course type Laurea Magistrale

Credits 6.0

Teaching hours Front activity hours: 54.0

For enrolled in 2022/2023

Taught in 2022/2023

Course year 1

Language

Curriculum CURRICULUM AEROSPACE SYSTEMS

Location Brindisi

Semester

Exam type Oral

Assessment

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

The course aims to show the complexity, critical aspects and opportunities of space missions and provide tools for their design.
The idea is to treat the subject to space mission projects for human spaceflights and automatic or robotic missions.

The course will start with a brief history of space exploration and an introduction to key space missions before reviewing Orbital manoeuvres.
It will present some basic characteristics of the space environment, robotic and human spacecraft and will introduce operational aspects of such vehicles. The course's emphasis will be on typical concepts like geosynchronous orbit, radiation belt, and Lagrange points.
Moreover, launcher technologies will be an important focus of this course.
In addition, we will provide tools to calculate, somewhat simplified manner, how to rendezvous in low Earth orbit and the calculation of interplanetary trajectories.
It will also focus on related onboard systems and energy management will be a subject of this course. Control of trajectories in low Earth orbit or in the solar system is related to managing energy and using as little propellant as possible to accomplish a particular objective.

REQUIREMENTS

Bachelor level courses in physics, vector analysis, and calculus

COURSE AIMS

The Space Missions Project and Systems (SMP-S) module aims at giving the knowledge necessary to design space missions and systems.

First, the course focuses on conceptualising space mechanics, manoeuvres, propulsion and control systems used in all spacecraft.
Space systems are then included in the broader concept of the space mission, which will be deeply analysed by studying the mission architecture, its elements, and their relations.
Finally, the student will gain knowledge of the challenges of using space environments as a scientific and commercial domain. He will also gain some hints about the geopolitics of space.
By the end of the course, the student must be able to:
– Assess/Evaluate space mission goals and objectives;
– Design the mission to reach the goal; and
– Assess/Evaluate competing designs.

Students will also learn to communicate effectively with professionals from other disciplines.

TEACHING METHODOLOGY

Lessons, exercises and workshops.

Delivery:
face to face

Learning activities:
During the course, a project is proposed.
The students, divided into small groups, will be asked to design different elements/systems for a space mission.
The project work is, in effect, a project laboratory: students must apply the knowledge acquired in-class hours to design the assigned task. Various design support tools, such as physical modelling (i.e. FREECAD, FUSION360) and some mathematical modelling (i.e. MODELICA/PYTHON/ EXCEL), will be used for the different types of analysis provided.

Attendance:
Mandatory Teaching

Non-attending students info
Special arrangements may be made for non-attending students on a case-by-case basis. Such arrangements must be agreed upon with the instructor before thestart of the course.

ASSESSMENT TYPE

Learning is verified through an oral examination of the topics covered during the course: tests will focus on theoretical arguments, the content of the project work/exercises, and the contributions made by company testimonials (if applicable).

Concerning the project work/exercises, the student is invited to present his copy of the final report, of which he will be asked to discuss a part chosen by the teacher. The report must be compulsorily submitted at the end of the course.

FULL SYLLABUS	– Types of space missions and their objectives – Space environment – General concepts of space vehicle architecture (i.e., spacecraft, launchers, space stations, sub-orbital platforms) – Applied orbital mechanics, including interplanetary trajectories and Rendez-vous in space – Launchers Market – Selected onboard systems – Spacecraft Examples: Space Shuttle, Space Station, Tethered Satellite, the Hubble Space Telescope.
REFERENCE TEXT BOOKS	Reference material prepared by the teacher and available on the course page on the teaching portal. The material is written in English. Some bibliography: - Space Mission Analysis and Design (SMAD), 3rd Edition, W.J. Larson and J.R. Wertz, Space Technology Library, Vol. 8 - Elements of Spacecraft Design, C.D. Brown, AIAA Education Series Mission Geometry; Orbit and Constellation Design and Management, - J.R. Wertz et alii, Space Technology Library, Vol. 13 Human Spaceflight; Mission analysis and Design, - W.J. Larson, Space Technology Series, McGraw Hill - ECSS standards (http://www.ecss.nl/) - NASA System Engineering Handbook, NASA/SP-2007-6105, Rev1.