Course guides
205067 - 205067 - Advanced Cubesat Mission Design

Last modified: 22/04/2021

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering.

Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN SPACE AND AERONAUTICAL ENGINEERING (Syllabus 2016). (Optional subject).

Academic year: 2021 **ECTS Credits:** 3.0 **Languages:** English

LECTURER

Coordinating lecturer: Miquel Sureda

Others: David González
Manel Soria
David de la Torre

PRIOR SKILLS

The student must have a good understanding of programming, mechanics (rigid-body dynamics), basics spacecraft design and orbital mechanics (two-body problem, Keplerian orbits, Hohmann transfer, basic impulsive maneuvers, launch geometry).

TEACHING METHODOLOGY

The course aims to address the design and construction of CubeSats in detail. Therefore, almost all the lessons are developed in a workshop like format, with students distributed in groups to work in a group project.

LEARNING OBJECTIVES OF THE SUBJECT

This course aims to give advanced knowledge of nano-satellites design, with particular emphasis on the design process and construction of CubeSats. As final outcome of the course, each group will define a CubeSat mission and will build and test its payload.

STUDY LOAD

Type	Hours	Percentage
Hours large group	27,0	36.00
Self study	48,0	64.00

Total learning time: 75 h

CONTENTS

Advanced CubeSat Mission Design

Description:
Introduction: CubeSat missions. Mission management and operations systems engineering.
Review of Orbit Design: The orbit design process. Launch vehicles. Earth coverage. Simple delta-V budgets. Selecting orbits. Common Examples.

Related activities:
Theory lessons.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

CubeSat Mission Definition

Description:
Mission Concept: Defining a payload and a CubeSat platform.
Mission Tiemeline: Design, production, test campagns, launch, deployment and operations.

Related activities:
- Theory lessons.
- Workshop.

Full-or-part-time: 12h
Theory classes: 4h
Self study : 8h

Advanced Subsystems Design

Description:
- Mechanical Design: Frameworks and structures, stress analysis, loads and stiffness, elastic instabilities, vibration, materials selection, structural analysis.
- Thermal Design: Thermal sources and transport mechanisms in space, thermal balance, thermal control elements, thermal design and implementation.
- Power Systems Design: Power generation, storage, regulation and monitoring. Harnesses and connectors, EMC, shielding and grounding, monitoring and protection.
- Comms and Data Handling Design: Tracking, telemetry and command systems. RF link, data handling, OBCs.
- Guidance, Navigation and ADCS Systems: Orbit determination and control. Attitude determination and control algorithms.
- Mechanisms: Mechanisms kinematics, bearings and lubrication. Motors, drives and wheels. Materials.

Related activities:
- Theory lessons.
- Workshop.

Full-or-part-time: 30h
Theory classes: 15h
Self study : 15h

Payload Design

Description:
Payload Design Production and Testing: Detailed design, production, ambient test campaign, environmental test campaign. Payload Delivery.

Related activities:
- Theory lessons.
- Workshop.

Full-or-part-time: 21h
Theory classes: 4h
Self study : 17h

GRADING SYSTEM

The course will be graded based on:

- Individual exercises: 30%
- Final group project: 70%

In case of being unable to hand the individual exercises or not passing them, the student will have a second opportunity.

BIBLIOGRAPHY

Basic:
- Wertz, James R.; Larson W. J. (eds.). Space mission analysis and design. 3rd ed. Dordrecht [etc.]: Kluwer Academic, 1999. ISBN 9781881883104.
- Fortesque, P.; Swinerd, G.; Stark, J. Spacecraft systems engineering [on line]. 4th ed. Chichester; New York: John Wiley & Sons, 2011 [Consultation: 21/07/2017]. Available on: http://site.ebrary.com/lib/upcatalunya/docDetail.action?docID=10494538&p00=spacecraft%20systems%20engineering. ISBN 9780470750124.

Complementary:
- Scholz, Artur (ed.). CubeSat standards handbook [on line]. The LibreCube Initiative, 2017 [Consultation: 07/05/2021]. Available on: https://www.pdffiller.com/416700999--CubeSat-Standards-Handbook-.

RESOURCES

Other resources:
Due to the characteristics of this course relevant web-based material and scientific publications are a very important source of information.