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205205 - Fundamentals of Cubesat Mission Design

Coordinating unit: 205 - ESEIAAT - Terrassa School of Industrial, Aerospace and Audiovisual Engineering

Teaching unit: 758 - EPC - Department of Project and Construction Engineering

Academic year: 2019

Degree: BACHELOR'S DEGREE IN AEROSPACE TECHNOLOGY ENGINEERING (Syllabus 2010). (Teaching unit Optional)
BACHELOR'S DEGREE IN AEROSPACE VEHICLE ENGINEERING (Syllabus 2010). (Teaching unit Optional)

ECTS credits: 3 Teaching languages: English

Teaching staff

Coordinator: Miquel Sureda

Others: David Gonzalez
Manel Soria
David de la Torre

Opening hours

Timetable: To be decided

Prior skills

The student must have a good understanding of basic physics, mechanics, electronics and materials science.

Teaching methodology

The course aims to address the design of CubeSats both from the theoretical and the practical point of view. Therefore, lectures are divided into:

- Theory classes, in which lecturers explain the main principles of Cubesats design.
- Hands-on activities, where students obtain direct practical experience in certain aspects of CubeSats technology.
- Teamwork time, for students to develop their final group project.

Learning objectives of the subject

The course aims to address the basics of artificial satellites design, with a special emphasis on the CubeSat platform and how the mission and the space environment itself affect its engineering.

Study load

Total learning time: 75h	Hours large group:	30h	40.00%
	Hours medium group:	0h	0.00%
	Hours small group:	0h	0.00%
	Guided activities:	0h	0.00%
	Self study:	45h	60.00%

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Content

Basic Space Mission Design	Learning time: 23h Theory classes: 10h Self study : 13h

Description:
Introduction: Mission and artificial satellites. Mission operations systems.
Basics of Orbit Design: The orbit design process. Two-body problem, Keplerian orbits and Hohmann transfer. Launch vehicles. Basic impulsive maneuvers.
Orbital Perturbations: Perturbation of the semi-major axis/orbital period, perturbation of the orbital plane and perturbation of the eccentricity vector.

Related activities:
- Theory lessons.
- Practical exercises.

Anatomy of a CubeSat Mission	Learning time: 26h Theory classes: 10h Self study : 16h

Description:
CubeSat Overview: Platform, applications and standards. A typical Cubesat mission.
Introduction to "qbapp" and "qbkit".

Related activities:
- Theory lessons.
- Practical exercises.
- Group project (work in progress).

Basic Subsystems Design	Learning time: 26h Theory classes: 10h Self study : 16h

Description:
- Structural Design: Frameworks and structures, loads and stiffness, materials selection, structural analysis.
- Thermal Design: Thermal sources and transport mechanisms in space, thermal balance.
- Power Systems Design: Power generation, storage, regulation and monitoring.
- 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.

Related activities:
- Theory lessons.
- Practical exercises.
- Group project (work in progress).

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Qualification system

The course will be graded based on:

- Individual exercises: 50%
- Final group project: 50%

Any student who wishes to improve his grade may try it at the exam planned at the end of the course. The best mark is preserved.

Bibliography

Basic:

Wertz, J.R.; Larson, W.J. Space mission analysis and design. 3rd ed. Dordrecht: Kluwer Academic, cop. 1999. ISBN 9781881883104.

Others resources:

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