Course guide
220333 - 220333 - Spacecraft Design

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 220 - ETSEIAT - Terrassa School of Industrial and Aeronautical 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: 2024 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Miquel Sureda

Others:

PRIOR SKILLS

Basic space engineering knowledge (Subject 220057 - Space Engineering)

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEESPAC2. MUEA/MASE: Advanced applied knowledge of orbital dynamics and space vehicle design (specific competency for the specialisation in Space).

TEACHING METHODOLOGY

The main objective of this course is to provide the required knowledge and ressources to design a space mission. A series of lectures will introduce the different aspects involved in a space mission design. The student will apply this knowledge and ressources to carry out an assignment and a project, with guidence and supervision during the whole semester.

A mid-term and final exam will test the knowledge adquired during the semester.

LEARNING OBJECTIVES OF THE SUBJECT

Ability to analyze and design a space mission:

This subject will provide the studen basic knowledge on Systems Engineering and Mission Analysis, as well as the required knowledge and ressources to design a space vehicle, including the payload and the following subsystems:

* Structures
* Electrical Power System
* Attitude Control
* Communication
* Navigation
* Propulsion
* Environmental Control and Life Support System

STUDY LOAD

Type	Hours	Percentage
Hours large group	30,0	24.00
Hours small group	15,0	12.00
Self study	80,0	64.00

Total learning time: 125 h

CONTENTS

Introduction

Description:
Introduction to the course.
Past, present and future of space missions: hystory of space missions, which missions are currently being carried out?, which are the future objectives of space agencies and private companies?

Related activities:
Mid-term Exam

Full-or-part-time: 5h
Theory classes: 2h
Self study : 3h

Systems Engineering

Description:
Introduction to Systems Engineering: what are the phases of a project? What is concurrent engineering? How can the cost of a mission be estimated?
Mission Concept Design: Definition of concepts such as mission statement, objectives, requirements and constrains.

Related activities:
Assignment

Mid-Term Exam

Full-or-part-time: 12h
Theory classes: 4h
Laboratory classes: 2h
Self study : 6h

Mission Analysis and Characterization

Description:
Review of orbital mechanics.
Identification of alternative mission concepts and architectures.
Preliminary concepts and trade-offs.

Related activities:
Project (Part 1: Mission Analysis and Characterization)
Mid-term Exam

Full-or-part-time: 41h
Theory classes: 6h
Laboratory classes: 5h
Self study : 30h

Spacecraft Subsystems

Description:
Review of Subsystems:
* electric power
* thermal control
* structures

Definition, design process and technology options for each subsystem:
* propulsion
* atittude and orbit determination and control
* communication and data handling
* environmental control and life support
* payload
* launchers

Related activities:
Project (Part 2: Prelinimary Design)
Final Exam

Full-or-part-time: 67h
Theory classes: 18h
Laboratory classes: 8h
Self study : 41h

GRADING SYSTEM

Final Grade = Project (70%) + Final Exam (30%)

For those students who meet the requirements and submit to the reevaluation examination, the grade of the reevaluation exam will replace the grades of all the on-site written evaluation acts (tests, midterm and final exams) and the grades obtained during the course for lab practices, works, projects and presentations will be kept.
If the final grade after reevaluation is lower than 5.0, it will replace the initial one only if it is higher. If the final grade after reevaluation is greater or equal to 5.0, the final grade of the subject will be pass 5.0

BIBLIOGRAPHY

Basic:
- Wertz, J.R.; Larson, W.J. Space mission analysis and design. 3rd ed. Dordrecht [etc.]: Kluwer Academic, cop. 1999. ISBN 9781881883104.
- Fortescue, P.; Swinerd, G.; Stark, J. Spacecraft systems engineering [on line]. 4th ed. Chichester; New York: Wiley, cop. 2011 [Consultation: 03/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=693314. ISBN 9780470750124.
- Messerschmid, E.; Bertrand, R. Space stations: systems and utilization. Berlin [etc.]: Springer, cop. 1999. ISBN 9783540654643.
- Larson, Wiley J. Human spaceflight: mission analysis and design. McGraw-Hill, 1999. ISBN 9780072368116.

Complementary:
- Eckart, Peter. Spaceflight life support and biospherics. Torrance, Calif.: Dordrecht; Boston: Microcosm Press; Kluwer Academic, 1996. ISBN 9781881883043.