Course guide
220340 - 220340 - Extension of Rocket Engines

Last modified: 19/04/2023

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: 2023 **ECTS Credits:** 5.0 **Languages:** English

LECTURER

Coordinating lecturer: Manel Soria Guerrero

Others:

PRIOR SKILLS

Previous concepts include knowledge of Thermodynamics and Propulsion systems for aircraft and spacecraft, given in any bachelor's degree in aerospace engineering and reviewed in previous subjects of this Master's degree, as well as familiarity with the use of computing tools for engineering. Good knowledge of at least one computer language (C, Matlab, Python..) is required, as most of the exercises involve code development and verification.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEPROP2. MUEA/MASE: Advanced applied knowledge of the design, manufacture and maintenance of propulsion systems (specific competency for the specialisation in Propulsion).

TEACHING METHODOLOGY

Lectures and hands-on sessions to solve problems with the help of computers.

LEARNING OBJECTIVES OF THE SUBJECT

Understand the design problems involved in a rocket engine.
Understand the fundamentals of cryogenic propellants.
Be able to review an actual rocket engine design using the theory learned in the subject.

STUDY LOAD

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

Total learning time: 125 h

CONTENTS

Module 1: Software for rocket engine preliminary design.

Description:
Review of ideal rocket equations and thermochemistry of rocket engines.
Introduction to the open-source codes HGS.
Analysis of a real rocket engine using HGS.

Full-or-part-time: 41h
Theory classes: 10h
Practical classes: 5h
Self study : 26h

Module 2: Cryogenic rocket propellants and rocket feed cycles.

Description:
Cryogenic rocket propellants.
Use of INIST code to obtain thermodynamic properties of cryogenic fluids.
Rocket feed cycles.
Case study: feasibility of electric feed rockets and batteries.

Full-or-part-time: 41h
Theory classes: 10h
Practical classes: 5h
Self study : 26h

Module 3: Project

Description:
Working in groups, the students will select a real rocket engine with enough available data and will study its design using the tools learned and developed in the subject. They are expected to develop software tools in order to analyse different design variants.

Full-or-part-time: 43h
Theory classes: 10h
Practical classes: 5h
Self study : 28h

GRADING SYSTEM

Class participation and class exercises: 30%
Assignments: 30%
Project: 40%
Students with a grade below 5 in the project, or the assignments, or the classroom participation, will be able to take an additional written exam covering all the subject, which will take place on the date fixed in the calendar of final exams. The grade obtained in this exam will range between 0 and 10, and will replace the part or parts below 5 only in case it is higher, up to a maximum of 5 points.

BIBLIOGRAPHY

Basic:
- Huzel, D.K.; Huang, D.H.; Arbit, N. Modern engineering for design of liquid-propellant rocket engines. Washington: American Institute of Aeronautics and Astronautics, cop. 1992. ISBN 9781563470134.
- Date, Anil W. Analytic combustion: with thermodynamics, chemical kinetics, and mass transfer. 1st paperback ed. New York: Cambridge University Press, 2014. ISBN 9781107448698.
- Horowitz, P.; Hill, W. The art of electronics. 3rd ed. New York: Cambridge University Press, 2015. ISBN 9780521809269.
- Datta, L.V.; Guven, U. Introduction to nanosatellite technology and components: applications of cubesat technology. Saarbrücken: Lap Lambert Academic Pub., 2012. ISBN 9783847314196.
- Sutton, G.P.; Biblarz, O. Rocket propulsion elements [on line]. 8th ed. New York: John Wiley & Sons, cop. 2010 [Consultation: 03/05/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=818989. ISBN 9780470080245.
- Millis, M.G.; Davis, E.W. Frontiers of propulsion science. Reston, VA: American Institute of Aeronautics and Austronautics, 2009. ISBN 9781563479564.