Course guide
220350 - 220350 - Aerospace Laboratories

Last modified: 02/04/2024

Unit in charge: Terrassa School of Industrial, Aerospace and Audiovisual Engineering
Teaching unit: 748 - FIS - Department of Physics.

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: Enrique Ortega

Others: Coma Company, Martí
Fariñas Gómez, Roberto
Farré Lladós, Josep
Sole Bosquet, Jaume

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CEEVEHI3. MUEA/MASE: Applied knowledge of composite materials technology and a capacity for designing the basic elements of these materials (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI2. MUEA/MAS: Sufficient applied knowledge of the aeroelasticity and structural dynamics of aircraft (specific competency for the specialisation in Aerospace Vehicles).
CEEVEHI1. MUEA/MAS: Sufficient applied knowledge of advanced, experimental and computational aerodynamics (specific competency for the specialisation in Aerospace Vehicles).

TEACHING METHODOLOGY

The course Aerospace Laboratory is divided into theoretical and laboratory sessions. The theoretical sessions aim to provide students with the basic concepts behind the typical experimental techniques and procedures. The main objective of the labs is to exemplify the application of experimental techniques and actual laboratory work by means of guided experiments. Under the supervision of the professors, the students will conduct the labs in an autonomous manner, working in small groups. To this end, a laboratory guide will be provided by the professors, specifying the objectives and the procedure to conduct the test. Only for experiments indicated by the faculty (3 or 4 during the course), each group will write a laboratory report according to specific requirements. The submission of these reports is mandatory for all groups. Additionally, the students will have to take an individual written test on the topics developed during the course. This will be carried out in the date scheduled for the final exam. The grades obtained in the written reports and final test will be taken into account for the calculation of the final grade of the subject (see Grading System).

LEARNING OBJECTIVES OF THE SUBJECT

Experimental techniques play an essential role in all fields of science and technology. They contribute to the understanding of physical phenomena and facilitate the creation of models for study and analysis. In addition, experimental techniques are vital for the diagnosis, monitoring and control of processes, as well as for product evaluation and certification. The scope of experimental techniques is very extensive and varied, as are the different techniques used.
The main objective of Aerospace Laboratories is to provide students an overview of typical experimental techniques applied in selected fields of aerospace engineering. The course is intended to help the students to acquire an adequate understanding of the principles of operation of the instruments and the methodology to conduct experimental procedures, and to develop their ability to generate and critically analyze experimental data.

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: fluid mechanics and aerodynamics

Description:
Introduction to fluid measurements.
Similarity requirements and scale effects. Uncertainties.
Overview of low-speed wind tunnels: constructive and operation features.
Basic instrumentation: pressure, temperature, data acquisition.
Velocity measurement in fluids: pitot-static probes, hot-wire, turbulence and boundary layers. Applications.
Introduction to Particle Image Velocimetry.

Related activities:
Laboratory experiments to be determined.

Full-or-part-time: 71h
Theory classes: 18h
Practical classes: 7h
Self study : 46h

Module 2: propulsion

Description:
Introduction and general description of turbojet engines.
Typical instrumentation in test benches. Measurement of the relevant operational parameters.
Test bench applications using a small turbojet engine.

Related activities:
Laboratory experiments to be determined.

Full-or-part-time: 27h
Theory classes: 6h
Practical classes: 4h
Self study : 17h

Module 3: rocketry

Description:
Introduction to solid fuel rockets.
Simulation tools: OpenRocket.
Analysis of the rocket ESEIAAT: components, functions, assembly and instrumentation.
Programming application for the acquisition and processing of video data.

Related activities:
Laboratory experiments to be determined.

Full-or-part-time: 27h
Theory classes: 6h
Practical classes: 4h
Self study : 17h

GRADING SYSTEM

The course will be graded by means of :

FG = 5*G_M1 + 2.5*G_M2 + 2.5*G_M3

where FG is the final grade of the course and G_M1, M2 and M3 are the individual grades obtained for Module 1, 2 and 3, respectively. These are calculated as the weighted average of the grades obtained in the written lab reports (0.8) and the final individual quiz (0.2) corresponding to each module.

Students who have a FG grade lower than 5 may resubmit (indiviudally or in groups) up to 3 written reports. The final result for the course will be a weighted average of the original (15%) and the final grade (85%). If the averaged grade obtained is lower than the previous grade, the latter is preserved.

Ressiting: those students who have not been successful in passing the subject and meet the requirements (FG equal or higher than 2.0) may choose to resit the final individual exam. If the grade obtained in the resit exam (FGr) is equal or higher than 5.0 the final grade for the subject will be passed 5.0, otherwise the subject will be graded as not passed with a grade obtained as max(FG,FGR).

BIBLIOGRAPHY

Basic:
- Barlow, J. B.; Rae, W. H.; Pope, A. Low-speed wind tunnel testing. 3rd ed. New York: John Wiley & Sons, 1999. ISBN 0471557749.
- Stine, G. Harry; Stine, Bill. Handbook of model rocketry. 7th ed. Hoboken, N.J.: J. Wiley, cop. 2004. ISBN 9780471472421.
- Flack, Ronald D. Fundamentals of jet propulsion with applications. Cambridge [etc.]: Cambridge University Press, 2005. ISBN 0521819830.

Complementary:
- Mattingly, Jack D. Elements of propulsion: gas turbines and rockets [on line]. Reston: American Institute of Aeronautics and Astronautics, 2006 [Consultation: 14/11/2022]. Available on: https://ebookcentral-proquest-com.recursos.biblioteca.upc.edu/lib/upcatalunya-ebooks/detail.action?pq-origsite=primo&docID=3111475. ISBN 1563477793.
- Goldstein, Richard. Fluid mechanics measurements. 2nd ed. New York [etc.]: Taylor & Francis, 1996. ISBN 156032306X.