Course guide
19393 - UAV - Unmanned Aerial Vehicles

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Unit in charge: Castelldefels School of Telecommunications and Aerospace Engineering
Teaching unit: 701 - DAC - Department of Computer Architecture.

Degree: MASTER'S DEGREE IN AERONAUTICAL ENGINEERING (Syllabus 2014). (Optional subject).
MASTER'S DEGREE IN AEROSPACE SCIENCE AND TECHNOLOGY (Syllabus 2015). (Optional subject).
MASTER'S DEGREE IN AEROSPACE SCIENCE AND TECHNOLOGY (Syllabus 2021). (Optional subject).

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

LECTURER

Coordinating lecturer: Defined in the course webpage at the EETAC website.

Others: Defined in the course webpage at the EETAC website.

PRIOR SKILLS

Operavility with the basic concepts of operation of an aircraft
Operavility with the basic concepts behind the air traffic management systems
Ability to perform application programs in Matlab / Octave or C # language or similar.

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
CE1 MAST21. Apply the scientific method to the study of the particular phenomenology of the aerospace environment.
CE2 MAST21. Apply systems engineering in the aerospace environment for the design and management of the different technological aspects associated with a mission.
CE3 MAST21. Carry out, present and publicly defend a research work carried out in a group, on a research topic in the aerospace field.

Generical:
CG1 MAST. Identify and learn about the main R+D+i activities in the aerospace field that are currently carried out internationally in academia, industry and the largest space agencies..
CG3 MAST. Identify and consistently manage the different types of aerospace vehicles and the technological, design and implementation aspects of payloads for scientific missions.

Transversal:
CT3. TEAMWORK: Being able to work in an interdisciplinary team, whether as a member or as a leader, with the aim of contributing to projects pragmatically and responsibly and making commitments in view of the resources that are available.

CT4. EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.

CT5. FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Basic:
CB7. Students will be able to apply the acquired knowledge and their ability to solve problems in new or little explored environments in broader (or multidisciplinary) contexts related to their study area.
CB8. Students will be able to integrate knowledge and face the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflections on social and ethical responsibilities linked to the application of their knowledge and opinions.
CB9. Students will be able to communicate their conclusions and the knowledge and ultimate reasons that support them to specialized and non-specialized audiences in a clear and unambiguous manner.
CB10. Students will acquire learning skills that allow them to continue studying in a way that will be largely self-directed or autonomous.

TEACHING METHODOLOGY

The classes of the subject will be presential and expositive. Teaching material will be composed of PowerPoint presentations (which can be obtained from the first day) and links to pages of special relevance. The software will also be used such as RAISE and X-Plane -for the full simulation of UAV operations. Group work will be one of the essential characteristics of the subject since the students will have to develop a project designing at the basic level the phases of a UAS mission and doing their exposition at the end of the course.
In particular, the teaching methodologies applied during the course will be:
MD1: Master class
MD2: Participatory expositive class
MD5: Autonomous work
MD6: Cooperative work

LEARNING OBJECTIVES OF THE SUBJECT

1- Understand what is a UAV, its components, basic operation and potential benefits in science and commercial missions.
2- Learn about the operation of UAV within NASA, its global surveillance objectives and types of UAS platforms: the Ihnana, the Global Hawk and the Sierra.
3- Understand the complexity of the UAS integration problem in non-segregated airspace: separation provision and collision avoidance.
4- Development of complex UAS simulation infrastructures, the RAISE System Architecture.
5- Flight planning for UAS, autopilots and the main requirements for mission automation.
6- UAS contingency management.
7- UAS regulation worldwide.

STUDY LOAD

Type	Hours	Percentage
Self study	80,0	64.00
Hours large group	45,0	36.00

Total learning time: 125 h

CONTENTS

Introduction to UAS

Description:
Understand what is a UAV, its components, basic operation and potential benefits in science and commercial missions.

Specific objectives:
- UAS history
- Types of UAS vehicles
- Components in a UAS
- Examples of successful operations

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

NASA UAS Operation History

Description:
Learn about the operation of UAV within NASA, its global surveillance objectives and types of UAS platforms: the Ihnana, the Global Hawk and the Sierra.

Specific objectives:
- The NASA Earth surveillance strategy
- The Ikhana vehicle and the wildfire monitoring missions
- The Global Hawk vehicle and the hurricane monitoring missions
- The Sierra vehicle and the ice monitoring missions

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

UAS Integration in non-segregated airspace

Description:
Understand the complexity of the UAS integration problem in non-segregated airspace: separation provision and collision avoidance.

Specific objectives:
- The airspace structure and the automated operation of UAS
- The separation provision and the ATC controller / UAS interaction
- Collision avoidance implemented by TCAS-II and its automation in UAS

Full-or-part-time: 9h
Theory classes: 6h
Self study : 3h

The RAISE simulation system

Description:
Development of complex UAS simulation infrastructures, the RAISE System Architecture.

Specific objectives:
- System overview and X-plane interaction
- Design of flight trajectories
- Real-time UAS simulation interface
- Data-logging interfaces

Full-or-part-time: 6h
Theory classes: 6h

UAS Flight Plan Design

Description:
Flight planning for UAS, autopilots and the main requirements for mission automation.

Specific objectives:
- Flight plan components and interaction with the airspace
- Impact of performance on flight plans
- UAS autopilots and its level of automation

Full-or-part-time: 9h
Theory classes: 6h
Self study : 3h

UAS contingency management.

Description:
Elements that define the implementation of flight plans to support UAS contingencies.

Specific objectives:
- Engine contingencies
- Lost-link contingencies
- UAS - ATM interaction during the contingency management
- Automation of the UAS contingency

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

UAS regulation worldwide.

Description:
Analysis of the UAS regulation and its current developments.

Specific objectives:
- The impact of ICAO on UAS regulations.
- The evolution of regulations in the EU and USA environments.
- Open aspects of the UAS regulatory scenario.

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

GRADING SYSTEM

Defined in the course webpage at the EETAC website.

RESOURCES

Other resources:
Defined in the course webpage at the EETAC website.