

Academic Year: ( 2022 / 2023 )

Review date: 31-05-2022

Department assigned to the subject: Department of Signal and Communications Theory

Coordinating teacher: GONZALEZ SERRANO, FRANCISCO JAVIER

Type: Electives ECTS Credits : 3.0

Year : Semester :

#### REQUIREMENTS (SUBJECTS THAT ARE ASSUMED TO BE KNOWN)

Digital Communications  
 Communication Channels and Systems  
 Electronic Systems

#### OBJECTIVES

- Know the basic structure of unmanned vehicles.
- Know the typical architecture of the on-board and ground systems, as well as their fundamental components.
- Design the architecture of the systems needed for the fulfillment of a specific mission.

#### DESCRIPTION OF CONTENTS: PROGRAMME

Unit 1. Introduction to RPAS / UAS (ES)

- History
- Elements: operating environment, air and ground segments; payload; support and maintenance
- Vehicle types and classification
- Applications: missions
- Regulations: operation
- Socio-economic impact

Unit 2. Technologies

- Propulsion
- \* Electric: Brushless motors, Electronic Speed Controllers (ESC)
- \* Others: piston, turbofan, ...
- \* Propellers
- Electric power)
- \* Batteries, Fuel Cells. Systems based on applied electrical energy, internal circuits of drones
- \* Converters (BEC)

Unit 3. Communications + Ground Segment: Ground Control Station

Communication

- \* Command and Control: RC Controller / Receiver
- \* Telemetry
- \* Data links: connectivity

Unit 4. Drone Fundamentals

- Configurations: 2/3/4/6/8-copter
- Basic flight maneuvers
- \* Performances

Guidance and control (Flight Control System)

- \* Autopilots. IMU. GPS
- \* Control software: mission planner

Unit 5. Design methodologies: Systems Engineering

- \* V & V: CONOPS, Requirements, Design, Testing

Design and manufacturing

- \* Materials
- \* Design software

\* 3D Printing

Unit 6. Payload (onboard)

- \* Sensed
- Optical (Visible, IR), RADAR, LiDAR, SONAR, Ultrasound
- \* Actuators: gimbals, etc

GCS + Processing (onground)

- \* Detection, classification, monitoring. Data Fusion.
- \* Information processing and analysis software

Practice 1: Drone Architecture and Components  
 Practice 2: Communications  
 Practice 3: Flight Control  
 Practice 4: Payload printing  
 Practice 5: Software Development  
 Practice 6: Calculation of airplanes:  
 - Configuration software: eCalc  
 - Race Drone vs surveillance Drone exercise  
 Practice 7: GCS and application design  
 Practice 8: Flight and Testing  
 - Plan mission + mission planner

#### LEARNING ACTIVITIES AND METHODOLOGY

Theory Classes: 0.75 ECTS  
 Practical/Lab. classes: 0.5 ECTS  
 Group Project: 1 ECTS  
 - Development of a project of systems integration in a UAV

Individual Project: 0.75 ECTS

The learning activities, methodology and tutoring regime will be organized according to the regulations specified by the university:

[https://www.uc3m.es/ss/Satellite/UC3MInstitucional/es/ListadoNormativas/1371206706530/Estudios\\_de\\_Grado](https://www.uc3m.es/ss/Satellite/UC3MInstitucional/es/ListadoNormativas/1371206706530/Estudios_de_Grado)

#### ASSESSMENT SYSTEM

End-of-term exam: 50 %  
 - The minimum passing score is 4 out of 10 points.  
 Group Project: 50 %

Class attendance (both Lectures and Laboratory) is mandatory in order to pass the subject.

<b>% end-of-term-examination:</b>	50
<b>% of continuous assessment (assignments, laboratory, practicals...):</b>	50

#### BASIC BIBLIOGRAPHY

- James Aber Irene Marzoff Johannes Ries Susan Aber Small-Format Aerial Photography and UAS Imagery, Academic Press. 2nd Edition., 2019
- Paul Gerin Fahlstrom Introduction to UAV Systems, John Wiley & Sons; 4th Edition, 2012
- Plamen Angelov Sense and Avoid in UAS, Wiley-Blackwell, 2012
- Reg Austin Unmanned Aircraft Systems: UAVS Design, Development and Deployment, Wiley-Blackwell; Edición: 1, 2010

#### ADDITIONAL BIBLIOGRAPHY

- Brent Terwilliger, David C. Ison, John Robbins Small Unmanned Aircraft Systems Guide: Exploring Designs, Operations, Regulations, and Economics, Aviation Supplies & Academics, Inc., 2017
- Douglas M. Marshall, Richard K. Barnhart, Eric Shappee, Michael Thomas Most Introduction to Unmanned Aircraft Systems, CRC Press, 2016