

Academic Year: ( 2022 / 2023 )

Review date: 08-04-2022

Department assigned to the subject: Signal and Communications Theory Department

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

Learning results:

- 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.

**% end-of-term-examination:** 50

**% of continuous assessment (assignments, laboratory, practicals...):** 50

## BASIC BIBLIOGRAPHY

- James Aber Irene Marzolf 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