Technologies for Autonomous and Unmanned Systems

Academic Year: (2022 / 2023) **Review date: 31-05-2022**

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

- 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

ASSESSMENT SYSTEM

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

Class attendace (both Lectures and Laboratory) is mandatory in orden to pass the subject.

% end-of-term-examination:	50
% of continuous assessment (assigments, laboratory, practicals…):	50

BASIC BIBLIOGRAPHY

- James Aber Irene Marzolff 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