# Autonomous Vehicles

**Academic Year: ( 2022 / 2023 )** **Review date: 09-06-2022**

**Department assigned to the subject: Systems Engineering and Automation Department**

**Coordinating teacher: ESCALERA HUESO, ARTURO DE LA**

**Type: Electives ECTS Credits : 3.0**

**Year : 1 Semester : 1**

## OBJECTIVES

Autonomous vehicles are a field of study where Robotics and Artificial Intelligence come together and that has great interest for its wide range of applications. This course will present the main technologies that are needed to develop Autonomous Vehicles in two major scenarios: land and air. The former, autonomous vehicles are already being tested on the roads of several countries and the latter, UAVs are already a reality to which the legislation will give them greater and greater autonomy. In both cases, the main hardware elements they carry, the sensors they carry, and the needs for perception, planning and control will be seen.

## DESCRIPTION OF CONTENTS: PROGRAMME

Part I Autonomous Vehicles

1.Introduction
- a. Importance and problems of transport
- b. What they are and advantages of autonomous vehicles
- c. History of autonomous vehicles

2.Software architecture
- a. Definition
- b. Elements

3.Sensors
- a. Necessity of perception
- b. Ultrasound
- c. Radar
- d. Cameras
- e. LiDAR
- f. GNSS/IMU

4.Perception of the environment
- a. Understanding of the road environment
- b. Calibration
- c. Computer Vision: classical approach.
- d. Computer Vision: Deep Learning

5.Maps and Location
- a. Types of maps
- b. Road map
- c. Location Map
- d. Occupancy map
- e. Localization algorithms

6.Planning
- a. Introduction
- b. Mission or route planner
- c. Behavior Planner
- d. Local or movement planner
- e. Collision check

7.Kinematic modeling and control of a vehicle

a. Kinematic and dynamic modeling
b. Bicycle model
c. Lateral control
d. Longitudinal control

8.Free resources

Part II Unmanned Aerial Vehicles

9.Introduction
a. Importance and problems of air transport
b. What they are and advantages of UAVs
c. Regulation of UAVs and future shared airspace

10.Aircraft control architectures
a. Definition and classification of aircraft
b. On-board autopilots and control devices
c. Basic control architectures
d. Systems for the detection and avoidance of dynamic obstacles in flight
e. Intelligent decision-making systems: safe navigation

11.3D trajectory planning
a. Autonomous aircraft navigation
b. Planning trajectories in urban environments
c. Vertipuertos and autonomous landing maneuvers in urban environments
d. Trajectory planning using GNSS receivers with differential correction
e. Automatic approach and automatic landing systems

12.Use cases
a. Parcel delivery in cities using vertipuertos
b. Inspection of cables and high voltage electrical towers
c. Inspection of photovoltaic solar plant installations
d. Extinguishing forest fires in hard-to-reach environments

## ASSESSMENT SYSTEM

Continuous evaluation based on personal work (60%), and two test-type exams carried out during classes (40%). In extraordinary call, the evaluation will be based on an written exam.

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| **% end-of-term-examination:** | 0 |
| **% of continuous assessment (assigments, laboratory, practicals…):** | 100 |