



IDENTIFYING DATA

Aerodynamics, flight mechanics and propulsion

Subject	Aerodynamics, flight mechanics and propulsion			
Code	007M189V01103			
Study programme	Máster Universitario en Sistemas Aéreos no Tripulados			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Mandatory	1st	1st
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	Orgeira Crespo, Pedro			
Lecturers	Orgeira Crespo, Pedro			
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Web	http://www.galiciadrones.es/			
General description	This subject aims to introduce the basic foundations that underlie the flight of any UAV: Aerodynamics, Flight Mechanics, and Propulsion. Its operating principles are described and the general concepts are reviewed.			

International students may request teachers: a) materials and bibliographic references to follow the subject in English, b) attend tutorials in English, c) tests and evaluations in English.

Training and Learning Results

Code	
A1	Possess and understand knowledge that provides a basis or opportunity to be original in the development and/or application of ideas, often in a research context
A2	That students know how to apply their acquired knowledge and problem-solving skills in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their area of study.
A3	That students are able to integrate knowledge and face the complexity of making judgments based on information that, being incomplete or limited, includes reflections on the social and ethical responsibilities linked to the application of their knowledge and judgments.
B1	That students acquire general knowledge in unmanned aerial systems engineering.
B5	That students are able to apply, in the field of unmanned aerial systems, the principles and methodologies of research such as literature searches, data collection, data analysis and interpretation, as well as the presentation of conclusions, in a clear, concise and rigorous manner.
C1	Knowledge about the main systems, on-board instruments and control station of an unmanned aircraft, as well as their influence on safety.
D8	Capacity for analysis and synthesis.
D9	Critical thinking skills and creativity.

Expected results from this subject

Expected results from this subject	Training and Learning Results
Understand the operation of a profile of flight, the basic performance of the aircraft and surfaces of control	A1 A2 A3 B1 B5 D8 D9

Learn which are the main systems of energy and propulsion	A1 A2 A3 B5 C1 D8 D9
Understand the basic principles of the mechanics of flight	A1 A2 A3 B1 B5 D8 D9

Contents

Topic	
Introduction	Historical approximation to unmanned aerial vehicles. Ranking of the aircraft and his systems of propulsion. Terrestrial infrastructures. Management of aerial traffic. Legal environment.
Unmanned air vehicles	Principles of flight. Aircraft performance. General description of fixed wing aircraft . Controls of flight. Structure. Main instruments and systems. General description of helicopters. Controls of flight. Main instruments and systems. Multicopters.
Fluid mechanics principles	Compressibility. Viscosity. Limit layer and turbulence. Reynolds number. Mach number. Bernoulli's equation.. ISA.
Aerodynamics principles	Airfoils in incompressible flow. Flat plate. Cylinder. Kutta condition. Prandtl.
Introduction to the propulsion of aircraft.	Propellers: Theory of Froude; theory of the element of shovel. Propeller adaptation. Aero jets. Push power, specific impulse and control of push in electric propulsion.
Flight mechanics	Basic flight equations. Cruise flight, ascend, descent and gliding. Banking. Wind effect. Actuators. Stability and control.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	40	61
Problem solving	18	45	63
Problem and/or exercise solving	3	0	3
Report of practices, practicum and external practices	0	20	20
Problem and/or exercise solving	3	0	3

*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.

Methodologies

	Description
Lecturing	Content presentation using audiovisual means. The contents will be upload to the e-learning platform.
Problem solving	Content presentation using audiovisual means. The contents will be upload to the e-learning platform.

Personalized assistance	
Methodologies	Description
Lecturing	e-mail and one-to-one tutorials
Problem solving	e-mail and one-to-one tutorials

Assessment						
	Description	Qualification	Training and Learning Results			
Problem solving	.	40	A1 A2 A3	B1 B5	C1	D8 D9
Report of practices, practicum and external practices	.	20	A1 A2 A3	B1 B5	C1	D8 D9
Problem and/or exercise solving	(*)Prueba parcial previa	40	A1 A2 A3	B1 B5	C1	D8 D9

Other comments on the Evaluation

Students will deliver all the required reports during the course. All have to reach at least a 5/10 score to pass.
 In June evaluation, a 5/10 is needed for students to pass the exam.
 In July evaluation, a 5/10 score is also needed in the exam, as well as having scored a 5/10 on required reports.

Sources of information

Basic Bibliography

Complementary Bibliography

Jeffrey D. Barton, **Fundamentals of small unmanned aircraft flight**,
 Aviation Civil Aviation Organization, **Unmanned aircraft systems**,
 Mouhamed Abdulla, Jaroslav V. Svoboda, Luis Rodrigues, **Avionics made simple**,
 Bon Dewitt, **Unmanned aerial systems for mapping**,
 Sergio Esteban Ronceso, **Fundamentos de Ingeniería Aeroespacial**,
 John Anderson, **Fundamentos de aerodinámica**, 6, McGraw Hill, 2017
 Miguel Ángel Gómez Tierno, **Mecánica de vuelo**, 2, Garceta, 2012
 Antonio Esteban Oñate, **Conocimientos del avión**, 1, Paraninfo, 2007

Recommendations

Subjects that continue the syllabus

Radio communication and navigation systems/O07M174V01103

Subjects that are recommended to be taken simultaneously

Unmanned aerial systems operations/O07M174V01102