



IDENTIFYING DATA

Aerodynamics, flight mechanics and propulsion

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|---------------------|---|-----------|------|------------|
| 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