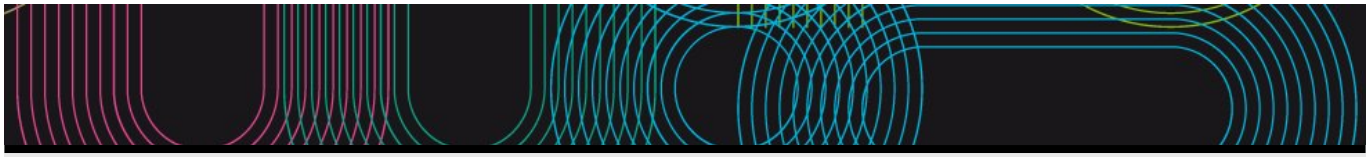

IDENTIFYING DATA				
Navigation and communication systems				
Subject	Navigation and communication systems			
Code	O07M189V01205			
Study programme	Máster Universitario en Sistemas Aéreos no Tripulados			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	1st	2nd
Teaching language	#EnglishFriendly Spanish			
Department				
Coordinator	González Jorge, Higinio			
Lecturers	González Jorge, Higinio González Valdés, Borja Rodríguez Vaqueiro, Yolanda			
E-mail	higiniog@uvigo.gal			
Web	http://www.galiciadrones.es/			
General description	This subject shows the fundamentals of the main navigation and communication systems used in drones.			

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.
A4	That students know how to communicate their conclusions -and the ultimate knowledge and reasons that support them- to specialized and non-specialized audiences in a clear and unambiguous manner.
A5	That students possess the learning skills that will enable them to continue studying in a manner that will be largely self-directed or autonomous.
B3	That students acquire the ability to analyze the needs of a company in the field of unmanned aerial systems and determine the best technological solution for it.
B4	That students acquire the knowledge to develop unmanned aerial systems and plan specific operations, depending on the existing needs and apply the existing technological tools.
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.
C3	Ability to interact with other technical teams in the engineering field for the planning of operations with unmanned aerial systems.
D6	Ability to work as part of a team.
D7	Organizational and planning skills.
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

To know the classic systems of communications and navigation.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9
To understand the operation of antennas and the range of the radio link.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9
To understand the operation of a positioning system based on ground aids.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9
To understand the operation of a satellite positioning system.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9

To learn the characteristics of automatic surveillance systems based on ADS-B.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9
Understand digital modulation systems.	A1 A2 A3 A4 A5 B3 B4 B5 C1 C3 D6 D7 D8 D9

Contents
Topic
1. Geodesy and aerial navigation.
2. Concept of frequency, wave and antenna. Wave propagation.
3. Navigation system based on ground aids.
4. Satellite-based navigation systems. ADS-B systems.
5. Inertial systems.
6. Complementary filter.
7. Kalman filter.
8. Friis formula. Noise, signal to noise ratio, BER and channel capacity.
9. Analog and digital modulations. Adaptive modulations.
10. MIMO techniques
11. Advanced satellite positioning. RTK

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	21	21	42
Practices through ICT	21	87	108

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

Methodologies	
	Description
Lecturing	
Practices through ICT	

Personalized assistance

Methodologies	**Description**
Lecturing	Attention by e-mail and videoconference.
Practices through ICT	Attention by e-mail and videoconference.

Assessment						
	Description	Qualification	Training and Learning Results			
Lecturing	Two multiple-choice tests.	50	A1	B3	C1	D6
			A2	B4	C3	D7
			A3	B5		D8
			A4			D9
			A5			
Practices through ICT	Practical work deliverables.	50	A1	B3	C1	D6
			A2	B4	C3	D7
			A3	B5		D8
			A4			D9
			A5			

Other comments on the Evaluation

The student has the right to opt for the global evaluation according to the procedure and the time limit established by the center established by the center for each call.

Sources of information

Basic Bibliography

Complementary Bibliography

Mike Tooley, David Wyatt, **Aircarft communications and navigation systems**, Elsevier, 2007

Eduardo Huerta, Aldo Mangiaterra, Gustavo Noguera, **GPS. Posicionamiento satelital**, UNR Editora, 2005

Myron Kayton, WAlter R. Fried, **Avionics navigation systems**, Wiley, 1997

Robert Arán Escuer, J. R. Aragoneses Manso, **Sistemas de navegación aérea**, Paraningo, 1983

Recommendations

Subjects that it is recommended to have taken before

Aerodynamics, flight mechanics and propulsion/O07M189V01103
Fundamentals of unmanned aircraft systems/O07M189V01101
Operations, legislation and certification/O07M189V01102
Observation systems/O07M189V01104