



## IDENTIFYING DATA

### (\*)Sistemas de navegación e comunicacións por satélite

Subject	(*)Sistemas de navegación e comunicacións por satélite			
Code	V05G300V01912			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits 6	Choose Optional	Year 4th	Quadmester 1st
Teaching language	English			
Department				
Coordinator	Aguado Agelet, Fernando Antonio			
Lecturers	Aguado Agelet, Fernando Antonio García Sánchez, Manuel Mosquera Nartallo, Carlos			
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General description	The contents of the subject cover the basics of satellite navigation and satellite communication systems: GPS and Galileo, the more usual landing systems and the different segments of satellite communication systems, and finally an introduction of the planning and development standards. The documentation of the course will be in English. It will be taught and assessed in English, allowing students to respond either in English, Spanish or Galician.			

## Competencies

Code	
A2	CG2: The knowledge, comprehension and ability to apply the needed legislation during the development of the Technical Telecommunication Engineer profession and aptitude to manage compulsory specifications, procedures and laws.
A3	CG3: The knowledge of basic subjects and technologies that capacitates the student to learn new methods and technologies, as well as to give him great versatility to confront and update to new situations
A4	CG4: The ability to solve problems with initiative, to make creative decisions and to communicate and transmit knowledge and skills, understanding the ethical and professional responsibility of the Technical Telecommunication Engineer activity.
A76	(CE67/OP10) Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of navigation and satellite communications systems.
A77	(CE68/OP11) The ability for selection of navigation and satellite communications systems and subsystems.

## Learning aims

Expected results from this subject	Training and Learning Results
To know and apply the basics of the navigation systems based on satellites: GPS, Galileo	A2 A3 A4 A76 A77
To propose complementary and alternative positioning systems.	A76
To know the more usual navigation systems and to specify the requirements for this application.	A2 A76 A77

To know how to select alternatives at system level of the different segments (space, ground and user) in function of the space mission and of the type of orbit.	A3 A4 A76 A77
To apply the planning and development standards of satellite systems.	A2 A3 A4 A76 A77

## Contents

Topic	
Introduction	<ul style="list-style-type: none"> <li>- System definition</li> <li>- Standards</li> <li>- Regulations</li> <li>- Allocated frequency bands</li> </ul>
Elements of a System	<ul style="list-style-type: none"> <li>- Ground Segment</li> <li>- Space Segment</li> <li>- Launch Segment</li> <li>- User Segment</li> </ul>
Architecture of the Subsystems of communications	Subsystems: <ul style="list-style-type: none"> <li>- Antennas</li> <li>- Payload: Hardware transponders</li> </ul>
Telecommunication services	<ul style="list-style-type: none"> <li>- Fixed Satellite Services (FSS)</li> <li>- Broadcast Satellite Services (BSS)</li> <li>- Mobile Satellite Services (MSS)</li> </ul>
Subsystems of communications	<ul style="list-style-type: none"> <li>- Waveforms</li> <li>- Standards</li> <li>- Multibeam Links</li> <li>- Feeder link</li> </ul>
Communication Link	<ul style="list-style-type: none"> <li>- Link Budget</li> <li>- Imperfections: linear distortions, non linear, atmospheric phenomena, interferences.</li> <li>- Performance: spectral efficiency, availability, latency.</li> </ul>
Introduction to navigation systems (GNSS)	<ul style="list-style-type: none"> <li>- GPS, Galileo, Glonass.</li> <li>- Instrument Landing System (ILS)</li> <li>- Positioning in wireless networks.</li> </ul>

## Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	21	42	63
Laboratory practises	13	26	39
Tutored works	7	35	42
Short answer tests	1	5	6

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

## Methodologies

	Description
Master Session	We describe the different topics of the subject providing all the necessary educational material.
Laboratory practises	Every student will apply the theoretical knowledge to 3 practical tasks covering the main part of the contents of the subject with the help of the Matlab Suit.
Tutored works	The student will perform two works in group, with the support of the professors, to apply, extend and personalize the contents covered in the theoretical and laboratory hours.

## Personalized attention

## Assessment

	Description	Qualification
Master Session	The master sessions will evaluate through the Laboratory practices , the tutored works and the short answer tests.	0
Laboratory practises	The students will realise 3 laboratory practices where they will work with concepts studied in the theoretical classes.	40
In these laboratory practices the skills A76, A77, A3 and A4 will be evaluated.		

Tutored works	Evaluation of the works developed: understanding, maturity, importance and originality of the work and interaction between the group.	15
	In these tutored works the skills A76, A77, A3 and A4 will be evaluated.	
Short answer tests	Three successive tests to evaluate the total contents presented in the subject. The tests will be individual and limits of time.	45
	In these short answers tests the skills A76, A77, A2, A3 and A4 will be evaluated.	

### Other comments on the Evaluation

**Both, documentation and presentations of this subject will be exclusively in English Language. The students may response the exams either in English or in any official language of the University of Vigo (Spanish and/or Galician).**

The subject will evaluate through the following mechanisms:

- **Questionnaires:** along the course will complete 3 questionnaires with a total weight of 40% of the final grade.
- **Practices of Laboratory:** each student will have to performance three practices in Matlab with a total weight of 40% of the final grade.
- **Delivery of relative reports to the works of classroom:** each student will have to do two works in group that will contribute with total weight of 20% of the final grade.

**Continuos Evaluation:** all the students will follow exclusively the procedure of continuos evaluation.

**Recovery at the end of the course:** the student will have to perform a final examination that substitutes the questionnaires done along the course, in addition to providing the practices and the equivalent work to be done as part of the continuos evaluation.

**The works and practical tasks proposals and performed during this course are only valid for the current course.**

### Sources of information

James R. Wertz, David F. Everett and Jeffery J. Puschell, **Space Mission Engineering: The New SMAD**,  
Maral and Bousquet, **Satellite Communications Systems: Systems, Techniques and Technology**,  
<http://www.ecss.nl>,  
Teresa M. Braun, Wiley, 2012., **Satellite Communications, Payload and System**,  
E. Lutz, M. Werner, A. Jahn, **Satellite Systems for Personal and Broadband Communications**,  
Organización de Aviación Civil Internacional, **Telecomunicaciones aeronáuticas : Anexo 10 al Convenio sobre aviación civil internacional. Volumen III, Sistemas de telecomunicaciones / Organizacion de Aviación Civil Internacional**,  
Elliott D. Kaplan, Christopher J. Hegarty, editors, **Understanding GPS : principles and applications**,  
Bernhard Hofmann-Wellenhof, Herbert Lichtenegger, Elmar Wasle, **GNSS : global navigation satellite systems : GPS, GLONASS, Galileo, and more**,  
[http://www.trimble.com/gps\\_tutorial/](http://www.trimble.com/gps_tutorial/),  
<http://www.insidegnss.com/magazine>,  
<http://igs.bkg.bund.de/>,  
<http://waas.stanford.edu/index.html>,

### Recommendations

#### Subjects that are recommended to be taken simultaneously

- (\*)Xestión e certificación radioeléctricas/V05G300V01612
- (\*)Xestión e dirección tecnolóxica/V05G300V01801
- (\*)Teledetección/V05G300V01911

#### Subjects that it is recommended to have taken before

- (\*)Transmisión electromagnética/V05G300V01303
- (\*)Sistemas de comunicacións por radio/V05G300V01512