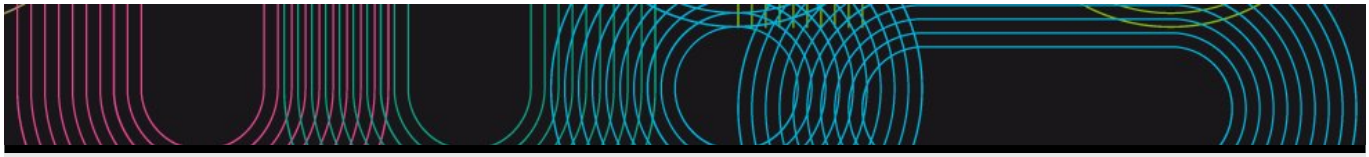

IDENTIFYING DATA				
Satellites				
Subject	Satellites			
Code	V05M145V01311			
Study programme	Máster Universitario en Ingeniería de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	5	Optional	2nd	1st
Teaching language	English			
Department				
Coordinator	Aguado Agelet, Fernando Antonio			
Lecturers	Aguado Agelet, Fernando Antonio Pérez Fontán, Fernando			
E-mail	faguado@tsc.uvigo.es			
Web	http://moovi.uvigo.gal			
General description	The contents of this course cover the basics of satellite standards, system engineering, the different segments of satellite systems, an introduction to product assurance and assembly, integration and verification procedures as well as an introduction to satellite operations. The course will be entirely conducted in English; the use of Spanish or Galego will be optionally allowed in the last exam.			

Training and Learning Results	
Code	
A2	CB2 Students must apply their knowledge and ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
B3	CG3 Ability to lead, plan and monitor multidisciplinary teams.
B7	CG7 Capacity for implementation and management of manufacturing processes of electronic and telecommunications equipment; guaranteeing safety for persons and property, the final quality of the products, and their homologation.
C18	CE18/RAD1 Capacity of elaborating, strategic planning, direction, coordination and technical and economic management of spatial projects applying spatial systems engineering standards, with knowledge of the processes a satellite operation.

Expected results from this subject	Training and Learning Results
To know and apply ECSS management space project standards.	C18
To know the basics of the system engineering applied to space projects.	A2 B3 C18
To know the mission life cycle of a space mission.	A2 C18
To know the documentation generated in each engineering phase in a space mission	A2 B3 C18
To know and ellaborate the main technical studies and budgets in a space mission.	B3 B7 C18
To know applicable methodologies and standards to product assurance (PA) and Assembly, Integration and Verification (AIV) procedures in a space project.	A2 B3 C18
To know the basics of satellite operation procedures and standards	C18

Contents

Topic	
International space project standards (Theoretical and Practical).	ECSS, NASA, INCOSE.
Space project life cycle (Theoretical and Practical).	Documentation and reviews.
Segments of a satellite project (Theoretical).	- Space Segment. - Ground Segment. - User Segment. - Launchers.
Satellite subsystems (Theoretical).	- Communication. - Mechanical & Thermal. - Power. - ADCS. - Propulsion. - On-board computer.
Product Assurance and Assembly, Integration and Verification Procedures in a space project (Theoretical and Practical).	- Product Assurance (PA) in space projects. - Assembly, Integration and Verifications (AIV) plans and procedures in space projects.
Introduction to satellite operations (Theoretical).	- Telemetry and Telecommand definition. - Operation procedures.
Analysis and simulation of two polarization effects, antenna pointing, and tropospheric propagation in satellite communications (Practical)	- Simulation of the pointing and polarization effects. - Effects of the troposphere.

Planning			
	Class hours	Hours outside the classroom	Total hours
Lecturing	13	39	52
Mentored work	2	6	8
Mentored work	2	6	8
Mentored work	2	6	8
Seminars	10	20	30
Problem and/or exercise solving	1	18	19
*The information in the planning table is for guidance only and does not take into account the heterogeneity of the students.			

Methodologies	
	Description
Lecturing	The different aspects of the subject are described, including the possibility of using the flipped learning methodology With this methodology A2, B3 and C18 competencies are covered.
Mentored work	Each student will apply the theoretical knowledge to evaluate the technical feasibility of a small satellite project proposed by the student. Phase 0. With this methodology A2, B3 and C18 competences are covered.
Mentored work	Each student will apply the theoretical knowledge to evaluate the technical feasibility of a small satellite project proposed by the student. Phase A. With this methodology A2, B3 and C18 competences are covered.
Mentored work	Each student will apply the theoretical knowledge to evaluate the technical feasibility of a small satellite project proposed by the student. Phase B1. With this methodology A2, B3 and C18 competences are covered.
Seminars	Each student will apply the theoretical knowledge to different practical tasks that cover the main part of the contents of the subject with the help of specific software. With this methodology A2, B7 and C18 competences are worked.

Personalized assistance	
Methodologies	**Description**
Lecturing	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page (https://moovi.uvigo.gal/user/profile.php?id=11661). They may also send their queries by email.

Seminars	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page (https://moovi.uvigo.gal/user/profile.php?id=11661). They may also send their queries by email.
Mentored work	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page (https://moovi.uvigo.gal/user/profile.php?id=11661). They may also send their queries by email.
Mentored work	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page (https://moovi.uvigo.gal/user/profile.php?id=11661). They may also send their queries by email.
Mentored work	The students will have the opportunity to attend tutorial hours with the university lecturers in the schedule that will be established and published in the subject web-page (https://moovi.uvigo.gal/user/profile.php?id=11661). They may also send their queries by email.

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The students will write a report of Phase 0 including the results obtained to justify the technical feasibility of the proposed small satellite mission. The evaluation will be based on the students' assistance to the master lessons, his or her participation on the seminars as well as the presented reports and oral presentations showing the obtained results.	15	A2 B3 B7 C18
Mentored work	The students will write a report of Phase A including the results obtained to justify the technical feasibility of the proposed small satellite mission. The evaluation will be based on the students' assistance to the master lessons, his or her participation on the seminars as well as the presented reports and oral presentations showing the obtained results.	15	A2 B3 B7 C18
Mentored work	The students will write a report of Phase B1 including the results obtained to justify the technical feasibility of the proposed small satellite mission. The evaluation will be based on the students' assistance to the master lessons, his or her participation on the seminars as well as the presented reports and oral presentations showing the obtained results.	15	A2 B3 B7 C18
Seminars	The students will perform simulations using specific software. The evaluation will be based on the students' assistance to the seminars, his or her participation on the seminars and a final report.	35	A2 C18
Problem and/or exercise solving	A final test to complement the evaluation of the contents presented in the master sessions. The test will be individual with time limit.	20	C18

Other comments on the Evaluation

Plagiarism is regarded as serious dishonest behavior. If any form of plagiarism is detected in any of the tests or exams, the final grade will be FAIL (0), and the incident will be reported to the corresponding academic authorities for prosecution

Within a maximum period of one month from the start of the course, the student must choose the method of evaluation for the ordinary opportunity: global assessment or continuous assessment. In case of having chosen continuous assessment, the grade cannot be 'not presented'. However, students can switch to global assessment one week before the final test. The extraordinary opportunity will always be assessed by global assessment, although, optionally, part of the continuous assessment grades can be taken into account.

Language of instruction: English.

All course documentation will be done in English, as well as the presentations.

The assessment of reports and practices will also be conducted in English.

The last exam can be answered in English, Galician, or Spanish.

1.- Ordinary opportunity

Global assessment:

The exam will include questions, problems, and practices related to the contents that are explained both in the master sessions, seminars, and supervised works. It will be necessary to get a 5 out of 10 to pass the exam.

Continuous assessment:

The subject will be evaluated throughout the course:

 Practice seminars: students will carry out 3 practices. Their evaluation will have a weight of 35% in the final grade.

 Tutored works: 3 works will be proposed throughout the course and the evaluation will be carried out through the correction of the corresponding reports, as well as their oral presentation. Each work will have a weight of 15% in the final grade.

 Short answer final test: this exam will be the final test of the continuous assessment and will have a weight of 20% of the final grade.

2.- Extraordinary opportunity:

The students will carry out a global assessment that will include topics and/or problems related to the content taught both in master sessions, seminars, and in supervised works (100% of the final grade). Students who chose continuous assessment for the first opportunity can optionally take this unique assessment for 65% of the final grade.

3.- End-of-program call:

The students will carry out a global assessment that will include topics and/or problems related to the content taught both in master sessions, seminars, and in supervised works (100% of the final grade). Students who chose continuous assessment for the first opportunity can optionally take this unique assessment for 65% of the final grade.

The practical tasks carried out in the course are not recoverable and are only valid for the current course.

Sources of information
Basic Bibliography
Course documentation and slides,
James R. Wertz, David F. Everett and Jeffery J. Puschell, **Space Mission Engineering: The New SMAD**, 4,
http://www.ecss.nl,
Complementary Bibliography
http://www.incose.org/,
NASA Systems Engineering Handbook, SP-2007-6105. Rev 1,
Peter Fortescue (Editor), John Stark (Editor), Graham Swinerd (Editor), **Spacecraft Systems Engineering**, 3,

Recommendations

Subjects that it is recommended to have taken before
Analog Electronic Circuits Design/V05M145V01106
Wireless and Mobile Communications/V05M145V01313