



IDENTIFYING DATA

Satellites

Subject	Satellites			
Code	V05M145V01311			
Study programme	Telecommunication Engineering			
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://fatic.uvigo.es			
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.			

Competencies

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.

Learning outcomes

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 elaborate 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	ECSS, NASA, INCOSE.

Space project life cycle	Documentation and reviews.
Segments of a satellite project	<ul style="list-style-type: none"> - Space Segment. - Ground Segment. - User Segment. - Launchers.
Satellite subsystems	<ul style="list-style-type: none"> - Communication. - Mechanical & Thermal. - Power. - ADCS. - Propulsion. - On-board computer.
Product Assurance and Assembly, Integration and Verification Procedures in a space project.	<ul style="list-style-type: none"> - Product Assurance (PA) in space projects. - Assembly, Integration and Verifications (AIV) plans and procedures in space projects.
Introduction to satellite operations	<ul style="list-style-type: none"> - Telemetry and Telecommand definition. - Operation procedures.

Planning

	Class hours	Hours outside the classroom	Total hours
Lecturing	13	39	52
Mentored work	6	18	24
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 CB2, CG3 and CE18 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.
	With this methodology CB2, CG3 and CE18 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 CB2, CG7 and CE18 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. 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. 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. They may also send their queries by email.

Assessment

	Description	Qualification	Training and Learning Results
Mentored work	The students will write 2 intermediate reports and a final report including the results obtained to justify the technical feasibility of the proposed small satellite mission.	45	A2 B3 C18
	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.		

Seminars	The students will perform simulations using specific software.	35	A2	C18
	The evaluation will be based on the students' assistance to the seminars, his or her participation on the seminars and a final report.			
Problem and/or exercise solving	A final test to complement the evaluation of the contents presented in the master sessions.	20		C18
	The test will be individual with time limit.			

Other comments on the Evaluation

In case of detection of plagiarism in some of the works or tests, the final qualification of the subject will be "suspended (0)" and the lecturers will communicate to the direction of the School the matter in order to take the measures it deems appropriate.

At the beginning of the term, the student will choose the assessment methodology for the first call: single evaluation or continuous evaluation. The second call will be always assessed by single evaluation.

The teaching language will be English.

Both, documentation and presentations of this subject will be exclusively in English.

English shall be used for writing the reports to evaluate the laboratory practices and the tutored works.

The students can use English, Spanish or Galego to respond the final short answer test.

First call

The subject will be evaluated through one of the following mechanisms:

Single evaluation:

- The exam will include questions, numerical problems and/or development of simulations, related with the contents presented in master sessions, seminars and tutored works. It will be necessary to obtain 5 points over 10 to pass the exam.

Continuous evaluation. The subject will be assessed throughout the entire term:

- **Seminars:** each student will have to perform different tasks with a total weight of 35% of the final mark.
- **Tutored works:** each student will participate in different tutored works proposed during the lecture period. This part will be evaluated by written reports as well as oral presentatios. This activity will have a total weight of 45% of the final mark.
- **Short answer test:** This exam will be the final assessment of the continuous evaluation, and it will have a total weight of 25% of the final mark.

Second call: the student will have to take an exam which will include questions and/or numerical problems related with the contents presented in the master sessions, seminars and the tutored works (100% of the final mark). Those students following the continuous evaluation, during the first call, can optionally take this exam for the 65% of the final grade.

All the different grades are only valid for the current course, and will expire after the second call in case someone needs to take the course again.

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

Contingency plan**Description**

=== EXCEPTIONAL PLANNING ===

Given the uncertain and unpredictable evolution of the health alert caused by COVID-19, the University of Vigo establishes an extraordinary planning that will be activated when the administrations and the institution itself determine it, considering safety, health and responsibility criteria both in distance and blended learning. These already planned measures guarantee, at the required time, the development of teaching in a more agile and effective way, as it is known in advance (or well in advance) by the students and teachers through the standardized tool.

=== ADAPTATION OF THE METHODOLOGIES ===

* Teaching methodologies maintained

Synchronous classes at the same time slots than the in-class teaching activities, supported by Campus Remoto and FAITIC. Other supplementary platforms may be used to guarantee the accessibility to teaching content.

* Teaching methodologies modified

In the case of a lockdown, more extensive use of a flipped learning methodology will be used, uploading to faitic support multimedia resources for selected lessons, including recorded video classes, podcast, quizzes as well as weekly activities to be completed by the students.

* Non-attendance mechanisms for student attention (tutoring)

Tutoring sessions may be carried out online: either asynchronously (e-mail, FAITIC forums, etc.) or by videoconference, in this case by appointment

* Modifications (if applicable) of the contents

The contents will be maintained in case of a health alert.

* Additional bibliography to facilitate self-learning

1.- Documentation for the audio opensource software Audacity: <https://manual.audacityteam.org>

2.- Documentation for the multimedia (video and audio) software OBS: <https://obsproject.com/wiki/>

3.- Documentation for python: <https://www.python.org/doc/>

4.- How to install a virtual machine using VirtualBox: <https://www.virtualbox.org/wiki/Documentation>

5.- GNURadio documentation: <https://www.gnuradio.org/docs/>

* Other modifications

No further modifications are expected since for the development of the activities for the mentoring work and seminars; the students will be used open-source or licensed software by UVIGO.

=== ADAPTATION OF THE TESTS ===

* Tests already carried out

Since the number of expected students in the subject is reduced, all the assessment will follow the same methodology than in case of in-class teaching activities. Only a final test is scheduled.

Final Test: [Previous Weight 20%] [Proposed Weight 20%]

* Pending tests that are maintained

Final Test: [Previous Weight 20%] [Proposed Weight 20%]

* Tests that are modified

No modifications of the tests are contemplated.

* New tests

No modifications of the tests are contemplated.

* Additional Information

In case of a lockdown, the students will present the results of the project reports (2 intermediate and a final), using a videoconference system.
