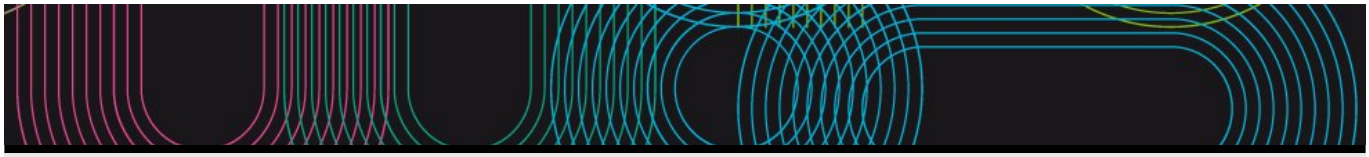

IDENTIFYING DATA				
Remote sensing				
Subject	Remote sensing			
Code	V05G300V01911			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	English			
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo Santalla del Río, María Verónica Torío Gómez, Pablo			
E-mail	inhigo@uvigo.es			
Web	http://faitic.uvigo.es			
General description	Remote Sensing is the topic devoted to all systems that allow the collection of data about object or surface characteristics without physical contact. This topic presents the basic principles of Remote Sensing, both in visible and infrared spectrum, and in microwaves. Special care will be put on active and passive sensors, with a deep explanation of RADAR and optic-electronic systems. The topic involves technological elements and signal processing, with a focus on the applications.			

Competencies	
Code	
B3	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
B4	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.
B7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
B9	CG9: The ability to work in multidisciplinary groups in a Multilanguage environment and to communicate, in writing and orally, knowledge, procedures, results and ideas related with Telecommunications and Electronics.
C65	(CE65/OP8)Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of radar and remote sensing systems.
C66	(CE66/OP9) The ability for selection of circuits, subsystems and systems of remote sensing.
D2	CT2 Understanding Engineering within a framework of sustainable development.
D3	CT3 Awareness of the need for long-life training and continuous quality improvement, showing a flexible, open and ethical attitude toward different opinions and situations, particularly on non-discrimination based on sex, race or religion, as well as respect for fundamental rights, accessibility, etc.
D4	CT4 Encourage cooperative work, and skills like communication, organization, planning and acceptance of responsibility in a multilingual and multidisciplinary work environment, which promotes education for equality, peace and respect for fundamental rights.

Learning outcomes			
Expected results from this subject	Training and Learning Results		
Identify and analyse problems that can be solved with Remote Sensing techniques	B3 B4 B9	C65	D4
Propose solutions based on RADAR, microwaves, infrared, LIDAR or visible spectrum observation	B3 B4 B9	C66	D3 D4

Specify sensors and Remote Sensing systems more adequate for each application	B3 B7	C65 C66	D2
Interpret and analyse images taken from satellites	B3 B4 B7	C65	D2

Contents	
Topic	
Introduction to Remote Sensing	The aim of this topic is to provide the students with a panoramic of the meaning and application of remote sensing of earth, sea and air. Special attention is given to different points of view between our usual perception of the Earth and its appearance when it is observed from a satellite or another airlifted platform. Besides, the subject exposes the historical evolution of the Remote Sensing and its implication in the human life, standing out the hits of the space exploration and the different programs that have been designed. The contents given in group A have an autonomous activity associated, called "The Earth from the air/space".
Fundamental concepts	The three fundamental concepts of Remote Sensing are the core of this topic: the spectral signature, the classification and the compositions of color. All this, after an introduction to the multispectral sensors.
Sensors	Explanation of the concept of sensor, introduction to the distinct types of sensors, the concept of resolution and calibration. Then, there is at least a session of two hours to the passive sensors (optical-electronic, thermal and radiometers of microwaves) and another session to the active sensors (RADAR and LIDAR). This explanation includes the foundations and operation, its characteristics, advantages and inconvenient and applications. The contents given in group A have several associated practices of laboratory (group B), those called "Sensors calibration", "Passive Sensors: infrared", and "RADAR Fundamentals".
Processing, interpretation and formation of images	This section is a summary of the distinct techniques of processing applied for interpreting and classifying images taken from satellites. It employs an image example to which all different processing techniques are explained. The subject also takes care of the formation of images of big regions of the surface of the Earth from images of areas more reduced, by means of the use of mosaics. It shows the process of the mosaic both from satellite and airborne images. Besides, image formation from radar data will be an important part of this topic. All the contents are given in laboratory (group B), for four sessions of 2 hour each. Besides, the works developed in group C will support the contents of this subject, focused on radar image formation.
Geographic Information Systems (GIS)	It treats to introduce the foundations and applications of the GIS, orienting all the exhibition to the support in the decisions process related with geographic locations. The second part of the session devotes to deepen in the knowledge of applications of GIS by means of the study of practical cases.
Terrestrial exploration	This section devotes of some examples of applications of the Remote Sensing in diverse fields: studies of the ground, agriculture, mining, geology. The own actuality at teaching time can determine the applications in which more upsetting is done. The contents given in group A could have associated some of the works developed by students in groups C, depending on the focus of each group challenge.

Meteorology and Oceanography	In this section, the applications that more satellites have used along the history of the Remote Sensing are exposed: the meteorology and the oceanography. In Meteorology, it indicates which types of sensors employ, analyses the different parameters of interest, the characteristics regarding resolution and the results of climatic studies along the planet. Regarding Oceanography, the subject focuses on the observed parameters, the sensors, and it also presents images that show the results of the observations both directly and after the application of distinct processed. The contents given in group A could have associated some of the works developed by students in groups C, depending on the focus of each group challenge.
Space exploration	The aim of the subject is to present a panoramic of the space exploration. Beginning with the sensors employed along the years of history of the humanity in the space, the subject shows the main knowledges that we have obtained from the distinct bodies of the solar system and it exposes how they arrived to this knowledge (missions, peculiarities of the ships and sensors employed, etc.).

Planning

	Class hours	Hours outside the classroom	Total hours
Master Session	17.2	25.8	43
Laboratory practises	4	8	12
Practice in computer rooms	10	15	25
Tutored works	5	45	50
Presentations / exhibitions	2	4	6
Autonomous practices through ICT	0	2	2
Introductory activities	1	1.2	2.2
Short answer tests	2.8	0	2.8
Systematic observation	0	2	2
Jobs and projects	0	5	5
*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	The course topics are presented and developed by the professor: foundations, theoretical bases, applications, etc. Group A sessions. 1 session/week. 2 hours/session Competences: CE65, CE66, CT2, and CG3
Laboratory practises	Experimental work on sensor calibration and infrared termography. Group B sessions. 2 sessions/semester. 2 hours/session. Competences: CE65, CE66, CT4, and CG4
Practice in computer rooms	Computer-based work on radar fundamentals and satellite imagery processing and interpretation. Group B sessions. 5 sessions/semester. 2 hours/session Competences: CG4, CG7, CG9, CT4, and CT3
Tutored works	The students will be assigned a simulation project. They will developed the project working in groups of 4-5 students. Project class sessions will be devoted to discussion and follow-up of the project. Group C sessions. 6 sessions/semester. 1 hour/session. Additional tutorial sessions will be scheduled if required. Competences: CG4, CG7, CG9, CT4, and CT3

Presentations / exhibitions	The students will present, in an open session, their project results. Previously, the students must e-mail to their group C teacher the code developed and a report summarizing the results. Group C sessions. 1 session/semester. 1 hour/session. Competences: CG9
Autonomous practices through ICT	Activities to be autonomously developed, with software provided by means of FaiTIC platform: "Earth from air/space", to learn about points of view. This methodology works on competences CE65 and CE66
Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the topic. For this activity reserves one face-to-face hour of group A, in which the professor presents the topic, explain the practices of laboratory and computer, and what expects of the works in group C. This methodology works on competences CE65, CE66, and CG4

Personalized attention

Methodologies	Description
Introductory activities	Time that each professor has reserved to attend and resolve doubts of the students.
Master Session	Time that each professor has reserved to attend and resolve doubts of the students.
Laboratory practises	Time that each professor has reserved to attend and resolve doubts of the students.
Practice in computer rooms	Time that each professor has reserved to attend and resolve doubts of the students.
Tutored works	Time that each professor has reserved to attend and resolve doubts of the students.
Presentations / exhibitions	Time that each professor has reserved to attend and resolve doubts of the students.
Autonomous practices through ICT	Time that each professor has reserved to attend and resolve doubts of the students.

Assessment

	Description	Qualification	Training and Learning Results		
Master Session	Proofs of short answer: there will be four proofs, at dates informed to the students at the beginning of the academic year, of 10 minutes length, that allows the student to pass part of the matters. In these short proofs the skils CE65, CE66, CG3 and CG7 will be evaluated.	40	B3 B7	C65 C66	
Laboratory practises	Systematic observation: During laboratory practices, the results and the demonstration of having understood the procedure to arrive to them will be evaluated: 1. "Sensors calibration": 5% 2. "Infrared thermography": 10% In these practices the skils CE66, CT3, CG4 and CG9 will be evaluated.	15	B4 B9	C66	D3
Practice in computer rooms	Systematic observation: During the computer practices , the results and the demonstration of having understood the procedure to arrive to them will be evaluated: 1. "Foundations of RADAR": 7% 2. "Image Processing": 13% In these practices the skils CE65, CT2 and CG4 will be evaluated.	20	B4	C65	D2
Tutored works	The works developed in C groups will be evaluated in two parts: the own dynamics of the works and the presentations. The work itself will receive 15% of the mark In these works the skils CE66, CG7 and CG9 will be evaluated.	15	B7 B9	C66	
Presentations / exhibitions	Presentations of the works developed by the groups In the presentation of the works the skils CG9 and CT4 will be evaluated.	7	B9		D4

Autonomous practices through ICT	Students will give the lecturer their autonomous work results: "The Earth from the air/space": 3% In these practices the skils CE65 and CG4 will be evaluated.	3	B4	C65	
Short answer tests	The final examination, in case to have to do it, will consist of 10 questions of short answer, with questions related with the classes of theory, of laboratory and the presentations of the works, and will cost by 100% of the note of the topic.	0	B3 B4 B7 B9	C65 C66	D2 D3 D4

Other comments on the Evaluation

The course language is English. **Tests, reports and exams should be written in English.**

Evaluation and grading.

The students can chose any of the following assessment systems:

1.- Continuous assessment. This consist of the following activities

1. Four quizzes. They account for 40% of the final grade.
2. Performance at lab classes. It accounts for a 35% of the final grade.
3. Simulation project results and report. 15% of the grade.
4. Project presentation. 7% of the grade.
5. Homework. 3% of the final grade.

Missed quizzes and/or lab classes will not be rescheduled.

Students attending to two of the 4 quizzes will be considered in the continuous assessment system.

Students that want to improve their grade may attend the final exam. Their final grade will be the average between the final exam and the continuous assessment grade.

2.- Final exam. It consists of a 10 questions exam. The exam can be taken up to two times per course. Time and place are published in the school web page. All material seen in the lectures, lab classes and project presentations is subject to questioning.

Final exams and quizzes must be worked out on everyone□s own. Any infraction will be considered a serious breach of ethics and reported to the academic authorities.

Sources of information

Emilio Chuvieco Salinero, **Teledetección ambiental**, Ariel,

Nicholas M. Short, Sr., **The Remote Sensing Tutorial**, Code 935, Goddard Space Flight Center,

Exploring the Moon, NASA,

Águeda Arquero Hidalgo, Consuelo Gonzalo Martín, Estíbaliz Martínez Izquierdo, **Teledetección: Una aproximación desde la superficie al satélite**, Fundación General de la UPM,

Fundamentals of Remote Sensing, Canadian Centre for Remote Sensing,

Gerald C. Holst, **Common Sense Approach to Thermal Imaging**, SPIE Optical Engineering Press,

Gary Jedlovec, **Advances in Geoscience and Remote Sensing**, In-Teh,

Iñigo Cuiñas, Verónica Santalla, Ana V. Alejos, María Vera-Isasa, Edita de Lorenzo, Manuel G. Sánche, **Playing LEGO Mindstorms® while Learning Remote Sensing**, International Journal of Engineering Education, vol. 27, no. 3, pp. 571-579,

Iñigo Cuiñas, Verónica Santalla, Pablo Torío, **Aprender jugando: fundamentos de Termografía en asignaturas de Teledetección**, Jornada de Innovación Educativa 2012,

Recommendations

Subjects that are recommended to be taken simultaneously

Navigation systems and satellite communications/V05G300V01912

Subjects that it is recommended to have taken before

Fundamentals of Sound and Image/V05G300V01405

Signal Transmission and Reception Techniques/V05G300V01404
Electromagnetic Transmission/V05G300V01303
Microwave Circuits/V05G300V01611
Radio Frequency Circuits/V05G300V01511
Optical Telecommunication Infrastructures/V05G300V01614
Principles of Digital Communications/V05G300V01613
Wireless Systems and Networks/V05G300V01615
Radio Communication Systems/V05G300V01512
Multimedia Signal Processing/V05G300V01513

Other comments

The topic is going to be taught in English.
All the documents will be in English.