Universida_{de}Vigo

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
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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 explaination of RADAR and optic-electronic systems.
	The topic involves technological elements and signal processing, with a focus on the applications.

Competencies

Code	
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.
A7	CG7: The ability to analyze and assess the social and environmental impact of technical solutions.
A9	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.
A74	(CE65/OP8)Applying conceptual, theoretical and practical tools of telecommunications in the development and applications of radar and remote sensing systems.
A75	(CE66/OP9) The ability for selection of circuits, subsystems and systems of remote sensing.

Learning aims

Expected results from this subject	Training and Learning Results
Analyze and specify radar systems, subsystems and radar signal	A3 A74
Analyze and specify passive sensors	A3 A75
Develop image forming algorithms.	A9 A74 A75
Suggest solutions based on microwave remote sensing, infrared remote sensing and remote sensing in the visible spectrum	A4 A7 A9

Contents

Topic

Introduction to Remote Sensing	Panoramic of the meaning and application of the distance observation of earth, sea and air, doing upsetting in the different points of view between our usual perception of the Earth and his appearance when it is observed from a satellite or another airlifted platform. Besides, it exposes the historical evolution of the Remote Sensing and his implication in the human life, standing out the appearances of the space exploration and the distinct programs that have gone conforming it. The contents given in group A have an autonomous activity associated, called "The Earth from the air/space".
Fundamental concepts	In this subject three fundamental concepts are explained: the spectral signature, the classification and the compositions of colour. 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. Afterwards, it devotes 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 exhibition includes the foundations and operation, its characteristics, advantages and inconvenient and applications. The contents given in group A have several practices of laboratory (group B) associated, those called "Sensors calibration", "Passive Sensors: infrared", and "RADAR Fundamentals". Besides, there will be an autonomous activity, "Microwave active RADAR".
Processing, interpretation and formation of images	The subject results a summary of the distinct techniques of processing applied for the interpretation and classification of images taken from satellites. It employs an image example to which go applying the distinct processed explained, for a better understanding of the applications of each technique. Besides, the subject occupies 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 exposes the process of the mosaic both from satellite and airborne images. All the contents are given in laboratory (group B), for four sessions of 2 hour each. Besides, the works developed in group C support the contents of this subject.
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	In this subject present some examples of applications of the Remote Sensing in diverse fields: studies of the floor, agriculture, mining, geology. The own actuality in the moment of teaching can determine the applications in which more upsetting is done. The contents given in group A have associated the work developed by students in groups C.
Meteorology and Oceanography	In this subject the applications that more satellites have occupied 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 distinct parameters of interest, the characteristics regarding resolution and the results of climatic studies along all the planet. Regarding Oceanography, the subject indicates 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.
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	Exhibition by the professor of the contents of the topic "Remote Sensing": foundations, theoretical bases, applications, etc. Reserves for the sessions of group A. This methodology works on competences A74, A75, and A3
Laboratory practises	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with the suitable equipment. They are two face-to-face sessions of 2 hours each one: one centred in calibration of sensors (using LEGO Mindstorm), and another in thermography by infrared (learning to handle termographic cameras). Both are developed in groups B. This methodology works on competences A74, A75, and A4
Practice in computer rooms	Activities of application of the knowledges to concrete situations and of acquisition of basic skills and procedures related with the matter object of study. They are developed in laboratories with computers. They are five sessions of two hours each one: 1. Foundations of RADAR, by means of a game of computer designed specifically, "RADAR Technology". 2. Processing and Interpretation of satellite images, with a program for processing LandSat images (it takes four sessions). This methodology works on competences A74, A75, A9, and A4
Tutored works	The student, in groups, prepares a document on an application of the Remote Sensing in the daily life. For this, the students will begin with a research of news on a subject that are propose to each group, related to the actuality, in which the remote sensing appear like a basic tool (for example, the research of corpses buried by a murderous, the follow-up of some floods, the study of the outlines of the continental plate under the ocean). The groups will begin for locating actual related news. From them, they will treat to identify the technologies, sensors, processing techniques, employee. They will have to look for technical and scientific information on these and, finally, elaborate a report and a presentation. The interaction with the professors will be face-to-face along five meetings of one hour each, and through forums during the research of information, and by email for the exchange of ideas. This methodology works on competences A4, A7, and A9
Presentations / exhibitions	Exhibition by part of the students in front of the professor and the rest of students of the work realised in small groups (C). These works will be presented as an activity of group A. This methodology works on competence A9
Autonomous practices through ICT	Activities to be autonomously developed, with software provided by means of FaiTIC platform: 1. "Earth from air/space", to learn about points of view. 2. "Microwave active RADAR", to learn on RADAR imaging. This methodology works on competences A74 and A75
Introductory activities	Activities directed to take contact and gather information on the students, as well as to present the topic. For this activity reserves a 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 A74, A75, and A4

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
Master Session	Proofs of short answer: there will be four proofs, the weeks 3, 6, 8 and 10, of 5-10 minutes of length, that allows the student to pass part of the matters. In these short proofs the skils A74, A75, A3 and A7 will be evaluated.	40
Laboratory practises	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Sensors calibration": 5% 2. "Infrared thermography": 10% In these practices the skils A75, A4 and A9 will be evaluated.	15
Practice in computer rooms	Systematic observation: During the practices of laboratory and computer, the obtaining of results and the demonstration to having comprised the procedure to arrive to them will be evaluated: 1. "Foundations of RADAR": 7% 2. "Image Processing": 13% In these practices the skils A74 and A4 will be evaluated.	20
Tutored works	The realisation of the works in 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 A75, A7 and A9 will be evaluated.	15
Presentations / exhibitions	Presentations of the works by part of the groups In the presentation of the works the skil A9 will be evaluated.	5
Autonomous practices through ICT	Students will give the lecturer their autonomous work results: 1. "The Earth from the air/space": 3% 2. "Active RADAR of microwaves": 2% In these practices the skils A74 and A4 will be evaluated.	5
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

Other comments on the Evaluation

All proofs will be performed in English.

The proofs of continuous evaluation allow the student to obtain a final qualification based only in his path along the course, and consist in:

1. Four proofs of short answer, with 10% of the total note each one, adding 40%.

2. Proofs of systematic observation in the practices of laboratory and computer, that add another 40%

3. Evaluation of the tutored works (15%) and of the presentation of the same (5%)

The tasks of continuous evaluation are not recoverable, and they are only valid for the current course. A student is supposed that has opted by continuous evaluation when he has done two of the proofs of short answer and he has attended two

practices of laboratory. A student that opts by the continuous evaluation is considered to be presented to the topic, independently that he attends or not the final examination.

If a student, having presented to continuous evaluation, opts for presenting to the final examination, the final mark of the topic will be the average of both.

According to the regulations of the University of Vigo, the student that wish has to be able to opt to 100% of the final note by means of an only final examination. The final examination is that he realises in the official dates marked in Board of School in the months of December or January (or July, in the case extraordinary exam), and to those that have to attend those students that have not opted by continuous evaluation and wish to approve the topic. The final examination will consist of ten brief questions related with the contents of the classes of classroom, of laboratory, and the presentations of the works.

The extraordinary examination will have a similar structure to the final examination.

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,

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Recommendations

Subjects that are recommended to be taken simultaneously
Satellite Navigation and Communication Systems/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
Spectrum Management/V05G300V01612
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.