



## IDENTIFYING DATA

### (\*)Teledetección

Subject	(*)Teledetección			
Code	V05G300V01911			
Study programme	(*)Grao en Enxeñaría de Tecnoloxías de Telecomunicación			
Descriptors	ECTS Credits	Choose	Year	Quadmester
	6	Optional	4th	1st
Teaching language	Spanish English			
Department				
Coordinator	Cuiñas Gómez, Íñigo			
Lecturers	Cuiñas Gómez, Íñigo Docio Fernández, Laura			
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General description	<p>Remote Sensing is the topic devoted to all systems that allow the collection of data about object or surface characteristics without physical contact.</p> <p>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.</p> <p>The topic involves technological elements and signal processing, with a focus on the applications.</p>			

## 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
(*CE65/*OP8) Apply the conceptual, theoretical and practical tools of the telecommunications in the development and applications of radar and remote sensing systems.	A74
*CG3 Knowledge of basic matters and technologies that prepare the student for learning of new methods and technologies, as well as that endow him of a large ability to adapt to new situations.	A3
(*CE66/*OP9) Capacity for the selection of circuits, subsystems and systems of remote observation.	A75
*CG4 Capacity to solve problems with initiative, taking decisions, creativity, and to communicate and transmit knowledges and skills, comprising the ethical and professional responsibility of the activity of the Technical Engineer of Telecommunication.	A4
*CG7 Capacity to analyse and value the social and environmental impact of the technical solutions.	A7
*CG9 Capacity to work in a multidisciplinary group and in some multilingual surroundings and to communicate, by writing as by oral form, knowledges, procedures, results and ideas related to the telecommunications and the electronics.	A9

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**Contents**

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## Topic

Introduction to Remote Sensing	<p>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.</p> <p>The contents given in group A have a practice of laboratory (group B) associated, called "The Earth from the air/space".</p>
Fundamental concepts	<p>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.</p>
Sensors	<p>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.</p> <p>The contents given in group A have several practices of laboratory (group B) associated, those called "Sensors calibration", "RADAR Fundamentals", and "active RADAR by microwaves", as well as a practice in group C, "Passive Sensors: infrared"</p>
Processing, interpretation and formation of images	<p>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.</p> <p>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.</p> <p>The contents given in group A have a practice of laboratory (group B) associated, called "Processing and interpretation".</p>
Geographic Information Systems (GIS)	<p>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.</p>
Terrestrial exploration	<p>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.</p> <p>The contents given in group A have associated the work developed by students in groups C.</p>
Meteorology and Oceanography	<p>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.</p> <p>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.</p>
Space exploration	<p>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.).</p>

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**Planning**

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	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	6	8
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

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 big group (A)
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). The first realises in average groups (B) and the second in small groups (C).
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. The Earth from the air/space, to learn on points of view. 2. Foundations of RADAR, by means of a game of computer designed specifically, "RADAR Technology". 3. Active RADAR by microwaves, based in Matlab, with a length of four hours. 4. Processing and Interpretation of satellite images, with a program for processing LandSat images .
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.
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 B.
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.

## 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.

## 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 skills 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 skills 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. "The Earth from the air/space": 5% 2. "Foundations of RADAR": 5% 3. "Active RADAR of microwaves": 10% 4. "Image Processing": 5%  In these practices the skills A74 and A4 will be evaluated.	25
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 skills 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 skill A9 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

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, Estibaliz 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 Jedlovac, **Advances in Geoscience and Remote Sensing**, In-Teh,

Iñigo Cuiñas, Verónica Santalla, Ana V. Alejos, María Vera-Isasa, Edita de Lorenzo, Manuel G. Sánchez, **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

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### Subjects that are recommended to be taken simultaneously

(\*)Sistemas de navegación e comunicacións por satélite/V05G300V01912

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

(\*)Fundamentos de son e imaxe/V05G300V01405

(\*)Técnicas de transmisión e recepción de sinais/V05G300V01404

(\*)Transmisión electromagnética/V05G300V01303

(\*)Circuitos de microondas/V05G300V01611

(\*)Circuitos de radiofrecuencia/V05G300V01511

(\*)Xestión e certificación radioeléctricas/V05G300V01612

(\*)Infraestruturas ópticas de telecomunicación/V05G300V01614

(\*)Principios de comunicacións dixitais/V05G300V01613

(\*)Redes e sistemas sen fíos/V05G300V01615

(\*)Sistemas de comunicacións por radio/V05G300V01512

(\*)Tratamento de sinais multimedia/V05G300V01513

### Other comments

The topic is going to be taught in English and Spanish.

All the documents will be in English.

Teaching at classroom (theory) and laboratory, groups A and B, will be taught in English.

Teaching at group C will be taught in Spanish.

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