

# Instrumentation and Remote Sensing (2500033)

## General Information

<b>School</b>	ETSECCPB
<b>Departments</b>	Departament d'Enginyeria Civil i Ambiental (DECA)
<b>Credits</b>	4.5 ECTS
<b>Programs</b>	GRAU EN ENGINYERIA CIVIL (pla 2020) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
<b>Course</b>	2024/25

## Main teaching language at each group

- Group 10CA2 Catalan (Q2)

## Faculty

Responsible Faculty: Carolina Puig Polo

Faculty: Alberto Díaz Delgado, Jose Antonio Gili Ripoll, Marta Monfort Codinach, Carolina Puig Polo

## Objectives of Education

- Geographic Information Systems. Metadata and Reference Systems. Raster and vector model. Georeferencing.
- Database. Data introduction and query in GIS. Spatial, vector and raster analysis. 3D information management (Digital terrain models).
- Introduction to Remote Sensing (R.S.). Fundamental concepts. Analysis, classification and treatment of images. New techniques for measuring and observing the Earth.

1 Ability to apply the concepts of passive and active remote sensing and to know the main existing sensors, as well as satellite missions of greater interest.

2 Ability to apply the basic concepts of Geographic Information Systems, studying the main formats and software.

3 Ability to perform spatial analysis of remote sensing information and its application through GIS tools to Civil Engineering.

Knowledge about the most modern methods of taking and processing spatial data, delving into acquisition methods and techniques for treating and interpreting remote sensing data. Know the basic concepts of data structure and the operation of Geographic Information Systems.

## Competencies

### Especific

Ability to analyze the problem of safety and health in construction sites. (Common module to the Civil branch)

Knowledge of the typology and calculation bases of prefabricated elements and their application in manufacturing processes. (Specific technology module: Civil Construction)

Knowledge about the project, calculation, construction and maintenance of building works in terms of structure, finishes, facilities and own equipment. (Specific technology module: Civil Construction)

Capacity for the construction and conservation of roads, as well as for the dimensioning, the project and the elements that make up the basic road equipment. (Specific technology module: Civil Construction)

Capacity for the construction and conservation of railway lines with knowledge to apply specific technical regulations and differentiating the characteristics of the mobile material. (Specific technology module: Civil Construction)

Ability to apply construction procedures, construction machinery and construction planning techniques. (Specific technology module: Civil Construction)  
 Capacity for the construction of geotechnical works. (Specific technology module: Civil Construction)

## Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	22.5 h	45.45 %
	Medium group	18.0 h	36.36 %
	Laboratory classes	4.5 h	9.09 %
	Guided Activities	4.5 h	9.09 %
Self Study		63.0 h	

## Contents

### General concepts of remote sensing and GIS

Basic description of the theoretical topics and activities to be carried out during the course Basic concepts of Geographic Information Systems and remote sensing, applications and software.

#### Specific Objectives

Give the student an overview of the subject Introduction to the basic fundamentals of Geographic Information Systems

### Geoinformation or geographic information (GI)

Data model: raster and vector and its structure in GIS. Creation of topology, topological properties and possible topological errors Creation of the raster and vector structure in GIS  
 Spatial Data Infrastructures (SDI)  
 Exercises for changing image header file formats, from raster to vector and from vector to raster.  
 Creation of 3D surfaces and digital elevation models  
 Conversion of data formats and structures.  
 Transformations of coordinate reference systems (datums and projections).  
 Editing symbology to create thematic maps using the information associated to the map.

#### Specific Objectives

Transformation and adaptation of geographic data, its integration and correct visualization in the GIS (eg from CAD to GIS)

### Geoprocessing or spatial analysis

GIS tools and techniques for combining vector maps and rasters: connectivity, proximity, inclusion.  
 Identification of sinks and their correction to the digital model dell terrain.  
 Creating flow direction and flow accumulation models  
 Obtaining the hierarchical drainage network and hydrological basins  
 Vector and raster spatial analysis tools with different quantitative or qualitative variables, which were necessary for decision making.

#### Specific Objectives

From a series of initial maps, obtain derived thematic maps using GIS spatial analysis tools  
 Obtaining the hierarchical drainage network with a specific density and the hydrological basins of a certain size  
 From a series of initial maps, obtain derived thematic maps using GIS spatial analysis tools, necessary for the proposed decision-making. Knowledge of GIS techniques and ability to apply them to the solution of basic and applied technological problems.

## Remote sensing

Physical foundations of remote sensing. The electromagnetic spectrum and radiometric terminology. Platforms and sensors. Copernicus Project. Combination of spectral bands and visual interpretation of the image

Analysis tools, supervised and non supervised spectral images to create thematic maps in GIS format

Explanation of different remote sensing applications. Radar images and applications (subsidence estimation). Carrying out a remote sensing project.

Remote sensing and instrumentation

### Specific Objectives

Acquisition of basic remote sensing knowledge

Creation of thematic maps from satellite images, through supervised classification.

Creation of new geoinformation from different geomatic and remote sensing techniques (radar, GNSS, LIDAR, etc.). Integrate layers from different data sources and formats into GIS.

## Activities

### Remote sensing project

#### Dedication

2h 30m

### GIS project

The student must carry out a specific tutored GIS work, individually or in groups, in which he must apply all the theoretical knowledge acquired and apply them with a specific GIS tool. The topic and work area will be free, but several works from previous courses will be published as a reference. The information will be obtained through the internet or generated by the student.

#### Dedication

2h

## Teaching Methodology

The course consists of 3 hours a week of face-to-face classes in the classroom (medium group), which are devoted to theoretical classes (the teacher presents the basic concepts and materials of the subject, presents examples and solves practical problems) and combines them with laboratory practices (in the computer room with specific GIS software) with greater interaction with students, in order to consolidate learning.

Support material is used in a detailed teaching plan format through the ATENEA virtual campus: contents, programming of assessment and directed learning activities and bibliography.

The language in which the course is taught will depend on the teacher, approximately 50% in Catalan and 50% in Spanish.

Although most of the sessions will be given in the language indicated, sessions supported by other occasional guest experts may be held in other languages.

## Grading Rules

*(\* The evaluation calendar and grading rules will be approved before the start of the course.*

The qualification of the subject is obtained from the qualifications of diverse practical activities so much individual as of group, of additive and formative character. It will take place throughout the course (inside and outside the classroom). The deliveries will be individuals and/or by subgroups by ATENEA, some of them with an oral presentation in the classroom.

# The final mark will be: FM = N-GIS of the GIS project or directed activity (40%) + N-TEL of the practical remote sensing work (60%).

Criteria of qualification and of admission to the re-evaluation:

The students who did not pass the ordinary evaluation, that have presented regularly in the proofs of evaluation of the subject will have option to realize a proof of re-evaluation in the period scheduled in the academic calendar. Students who have already passed it or students qualified as not presented will not be able to take the re-assessment test for a subject. The maximum grade in the case of taking the re-assessment exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the set period may not lead to the performance of another test with a later date. Extraordinary assessments will be conducted for those students who, due to accredited force majeure, have not been able to take any of the continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the teacher responsible for the subject, and will be carried out within the corresponding teaching period.

## Test Rules

If you do not perform any of the laboratory activities or continuous assessment during the period scheduled, will be considered as zero score.

The attendance at some labs and field practices (DGPS or GPS for GIS) is mandatory in order to obtain a mark greater than zero.

## Office Hours

From Monday to Friday by previous e-mail or notification to the teacher of the topic and online by the forum of FAQs of practices at Atenea

## Bibliography

### Basic

- Peña Llopis, J. [Sistemas de información geográfica aplicados a la gestión del territorio: entrada, manejo, análisis y salida de datos espaciales: teoría general y práctica para ESRI ArcGIS 9](#). 4a ed. San Vicente (Alicante): Club Universitario, 2010. ISBN 9788484549987.
- Chuvieco, E. [Fundamentos de teledetección espacial](#). 3a ed. revisada. Madrid: Rialp, 1996. ISBN 843213127X.
- Woodhouse, I.H. [Introduction to microwave remote sensing](#). Boca Raton, FL: CRC Press, Taylor & Francis Group, 2006. ISBN 9781315272573.

### Complementary

- Gómez Delgado, M.; Barredo, J.I. [Sistemas de información geográfica y evaluación multicriterio en la ordenación del territorio](#). 2a ed. Paracuellos de Jarama: Ra-Ma, 2005. ISBN 8478976736.
- Burrough, P.A.; McDonnell, R.A.; Lloyd, C.D. [Principles of geographical information systems](#). 3rd ed. Oxford: Oxford University Press, 2015. ISBN 9780198742845.