Course guide
310646 - 310646 - Remote Sensing

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Unit in charge: Barcelona School of Building Construction
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: BACHELOR'S DEGREE IN GEOINFORMATION AND GEOMATICS ENGINEERING (Syllabus 2016). (Compulsory subject).

Academic year: 2025 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: Puig Polo, Carolina

Others: Castillo Rosas, Juan Daniel
Puig Polo, Carolina

TEACHING METHODOLOGY

The teaching methodology is based on the practical and immediate application of the concepts developed in the theoretical classes. The course is structured into 4 hours per week of face-to-face instruction: 2 hours in a large group, devoted to the development of theoretical content, and 2 hours in a small group, focused on practical work.

The theoretical classes will be delivered through participatory lectures supported by audiovisual materials, promoting active learning methodologies such as guided interpretation and problem-based learning (PBL).

Practical sessions will take place in the computer lab, using free and open-source software such as SNAP and QGIS, together with open-access satellite data. Learning is oriented towards mastering professional workflows through the analysis of real case studies, applied micro-projects, and collaborative work.

LEARNING OBJECTIVES OF THE SUBJECT

In this course, the basic knowledge of remote sensing will be provided and the tools to put this acquired knowledge into practice and tackle real problems, to which remote sensing offers a reliable solution, will be explained.

The learning objectives are:
• Understand the fundamental principles of remote sensing.
• Search for and gather remote sensing data.
• Understand the various dimensions of remote sensing data.
• Process remote sensing images.

STUDY LOAD

Type	Hours	Percentage
Hours large group	24,0	16.00
Hours medium group	36,0	24.00
Self study	90,0	60.00

Total learning time: 150 h

CONTENTS

1. Introduction to remote sensing

Description:
It introduces the general concepts of remote sensing, its evolution, applications, and the fundamentals of Earth observation from an applied perspective. The electromagnetic spectrum and the interaction between radiation and the Earth's surface are addressed.

Specific objectives:
- Analyze the concept of remote sensing and its role in studies of the Earth's surface.
- Identify current applications of remote sensing.
- Recognize the basic principles of Earth observation.
- Understand the interaction between radiation and the Earth's surface.

Full-or-part-time: 8h
Theory classes: 4h
Practical classes: 4h

2. Physical Principles of Remote Sensing

Description:
In this topic, we will study the interaction of electromagnetic waves with the Earth's surface and their spectral response in different parts of the electromagnetic spectrum.

Specific objectives:
The electromagnetic spectrum: terms and units of measurement.
Characteristics of energy radiation in the optical spectrum.
Characteristics of energy radiation in the thermal infrared spectrum.
The microwave region

Full-or-part-time: 4h
Theory classes: 2h
Practical classes: 2h

3. Platforms and sensors

Description:
Introduction to Earth Observation (EO) platforms and sensors. This unit analyzes the fundamental distinctions between active and passive sensors, as well as the resolutions (spatial, temporal, spectral, and radiometric) that define image quality. The course delves into orbital dynamics (sun-synchronous and geostationary orbits) and their relationship with the sensor's revisit cycle. Finally, major space programs are studied, with a specific focus on the European Copernicus program and the Sentinel constellation.

Specific objectives:
- Categorize sensors according to their nature and the type of data they generate.
- Identify the orbits and technical characteristics of the primary EO missions.
- Access and utilize Copernicus program data repositories for geomatic applications.

Full-or-part-time: 8h
Theory classes: 4h
Practical classes: 4h

4. Interpretation and analysis of images

Description:
Study of information extraction techniques from multispectral data. This unit covers the spectral signature of different land covers and the calculation of spectral indices (NDVI, NDWI, NBR) for characterizing vegetation, water, and burned areas. It introduces the fundamentals of image classification, analyzing supervised and unsupervised methods, as well as accuracy assessment using confusion matrices.

Specific objectives:
- Generate and interpret spectral index maps for environmental monitoring.
- Execute classification workflows (e.g., Random Forest or Maximum Likelihood).
- Statistically validate the results of image classification.

Full-or-part-time: 10h
Theory classes: 4h
Practical classes: 6h

5. Active Remote Sensing

Description:
Study of observation systems based on self-emitted radiation within the microwave spectrum. This unit analyzes the principles of Synthetic Aperture Radar (SAR), signal interaction with the surface (scattering mechanisms), and the influence of surface roughness and dielectric constant. It delves into the geometric distortions inherent to side-looking radar (layover, foreshortening, and shadowing) and image properties (amplitude, phase, and speckle noise).

Specific objectives:
- Understand radar image formation and the fundamental differences from passive sensors.
- Identify and visually correct geometric distortions in areas with significant relief.
- Interpret radar signal response based on land cover type (vegetation, water, urban areas).

Full-or-part-time: 20h
Theory classes: 6h
Practical classes: 14h

6. Remote Sensing Aplications

Description:
This unit analyzes the most relevant applications of remote sensing within the fields of engineering and the environment. It explores the use of satellites and sensors for land management, emphasizing forest fire prevention and monitoring. Furthermore, it delves into water resource management and aquatic remote sensing (water quality and bathymetry), identifying the specific resources and sensors required for each type of study.

Specific objectives:
- Select the optimal sensor and platform for forest and water management applications.
- Apply processing techniques for burned area delineation and water body analysis.
- Familiarize with specific data products from missions such as Sentinel-1, Sentinel-2 and Sentinel-3 for environmental monitoring.

Full-or-part-time: 10h
Theory classes: 2h
Practical classes: 8h

GRADING SYSTEM

This course is passed through Continuous Learning and Assessment (CLA).
Below is a summary of the grading method. Additional details about the method will be provided on the first day of class.

The ordinary grade for the course is obtained from the continuous assessment grades, which consist of two types of marks:
• Ne: exam mark. Two tests with a weight of 40% for the first and 60% for the second test. The dates for these tests will be set by the school.
• Nlab: laboratory mark.

The final grade (FG) for the course is calculated as:
FG = 80% Ne + 20% Nlab.

The weight of each practice assignment will be detailed in the course's Atenea platform. Each practice assignment must be submitted within the indicated deadline; late submissions will not be accepted without a justified cause and prior notice.

Grading criteria and admission to Re-assessment:
Students who fail the ordinary assessment, who have taken the course assessment tests, and who have attended and submitted the practice assignments (>80%), will have the option to take a re-assessment test during the period set in the academic calendar.
This test will assess the theoretical part of the course and the practical part corresponding to the laboratories.
Students who have already passed the course or those who are marked as not presented will not be eligible to take the re-assessment test. The maximum grade for taking the re-assessment exam will be five (5.0). The absence of a student called to the re-assessment test, held within the fixed period, will not result in another test being scheduled at a later date.

EXAMINATION RULES.

In order to be eligible to take the course examinations, the student must have submitted all the assigned coursework within the established deadlines. Failure to comply with this requirement will prevent the evaluation of the theoretical examinations (Ne).

BIBLIOGRAPHY

Basic:
- Woodhouse, Iain H. Introduction to microwave remote sensing . Boca Raton : Taylor & Francis, 2006. ISBN 0415271231.
- Campbell, James B. Introduction to remote sensing. 4th. New York: The Guilford Press, 2007. ISBN 9781593853198.
- Chuvieco Salinero, Emilio. Fundamentos de teledetección espacial . 3ª ed., revisada. Madrid : Rialp, 1996. ISBN 843213127X.
- Jorge Lira. Tratamiento digital de imágenes multiespectrales. México: UNAM, 2018. ISBN 979-8598872598.