Course guide
310622 - 310622 - Remote Sensing

Last modified: 07/07/2024

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: 2024 **ECTS Credits:** 4.5 **Languages:** Catalan

LECTURER

Coordinating lecturer: Puig Polo, Càrol

Others: Puig Polo, Càrol

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
1. Knowledge, application and analysis of the processes of treatment of digital images and special information, proceding from airborne and satelite sensors.
2. Knowledge, use and application of the treatment techinques. Analysis of special data. Study of models applied to the engineering and architecture.

Transversal:
3. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.
4. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.

TEACHING METHODOLOGY

The teaching methodology is based on a practical and immediate application of the concepts developed in the theoretical classes. The course consists of 3 hours per week of face-to-face classes in the classroom: 1 hour in a large group and 2 hours with half of the students (small group) dedicated to course practices. All course material will be available on the ATENEA virtual campus, including content, programming of evaluation activities and directed learning, and bibliography.

Although most of the sessions will be taught in the language indicated in the guide, sessions with guest experts may occasionally be conducted in another language.

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.
- Understand essential image analysis techniques.
- Access cloud services and software packages compatible with remote sensing.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	27,0	24.00
Self study	67,5	60.00
Hours large group	18,0	16.00

Total learning time: 112.5 h

CONTENTS

1. Introduction to remote sensing

Description:
Introduction to the subject
A bit of history and latest developments

Related activities:
LAB1: Visualization and interpretation of satellite images. Tools of work

Full-or-part-time: 7h 30m
Theory classes: 2h
Practical classes: 1h
Self study : 4h 30m

2. Physic principles of remote sensing in the optic

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:
Remote sensing in the optic (visible, proximus infrared)
Reflectance and spacial signature.
Macroscopics effects: reflection, refraction, absortion, diffusion and transmision.
Spacial resolution, radiometry, spectral and temporal

Related activities:
LAB1: Visualization and interpretation of satellite images. Tools of work

Full-or-part-time: 12h 30m
Theory classes: 3h
Practical classes: 2h
Self study : 7h 30m

3. Platforms and sensors

Description:
In this section, Earth observation satellites and sensors will be discussed, highlighting the main distinctions according to the type of sensor (passive or active) that generates the image, as well as the characteristics of these images. The Earth observation programs, especially the Copernicus program, will also be covered.

Specific objectives:
Types of sensors: active and passive.
Types of resolution: spatial, spectral, radiometric, and temporal.
Satellite characteristics: orbits and swaths.
Landsat Program. Copernicus Program. Commercial satellites with high spatial resolution.
Earth observation satellites and sensors, meteorological, maritime, and other types of sensors.

Related activities:
LAB1: Visualization and interpretation of satellite images. Tools of work

Full-or-part-time: 25h
Theory classes: 4h
Practical classes: 6h
Self study : 15h

4. Interpretation and analysis of the images

Description:
In this topic, the image analysis techniques, which are key to conducting any analysis, will be examined more closely. Data analysis has changed significantly in recent decades, and the number of options to choose from, when it comes to analyzing remote sensing images, provides a wide variety of tools for every purpose. The most common techniques as well as the newest ones have been selected.

Specific objectives:
Spectral indices: vegetation, water, snow and ice, burned area.
"Machine Learning and Deep Learning" algorithms for multispectral image classification.
Supervised classification
Unsupervised classification
Classification validation

Related activities:
LAB 2A: Vegetation, Water, and Burned Area Indices
LAB 2B: Ice and Snow Indices
LAB 3: Classification of Multispectral Images

Full-or-part-time: 25h
Theory classes: 4h
Practical classes: 6h
Self study : 15h

5. Remote sensing by microwaves

Description:
In this topic, you will explore a detailed overview of radar technology history. All the necessary fundamentals to understand how electromagnetic waves work will be covered. Additionally, a lab session will be conducted where radar data will be explored in various application scenarios.

Specific objectives:
- History of radar technology and the discovery of electromagnetic waves
- Geometry of image acquisition in airborne and spaceborne radar systems
- Land applications of radar remote sensing
- Applications of radar remote sensing over water
- Application of radar remote sensing for risk management

Related activities:
LAB 4: Introduction to SAR Images. Floods and Deforestation

Full-or-part-time: 22h 30m
Theory classes: 3h
Practical classes: 6h
Self study : 13h 30m

6. Remote Sensing Aplications

Description:
In this topic, we will explore the most relevant applications of remote sensing. Satellites, sensors, and specific resources will be discussed in the management of territory and forest fires, in water resource management, and in aquatic remote sensing.

Full-or-part-time: 20h
Theory classes: 2h
Practical classes: 6h
Self study : 12h

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.

To be able to carry out the exams of the subject the student must have delivered in the established schedule the proposed projects.

BIBLIOGRAPHY

Basic:
- Campbell, James B. Introduction to remote sensing. 4th. New York: The Guilford Press, 2007. ISBN 9781593853198.
- Woodhouse, Iain H.. Introduction to microwave remote sensing [on line]. Boca Raton: Taylor & Francis, 2006Available on: https://discovery.upc.edu/permalink/34CSUC_UPC/5rq1ap/alma991005083779906711. ISBN 0415271231.