Course guide
2500220 - GEA0220 - Instrumentation, Remote Sensing and Big Data

Last modified: 01/10/2023

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

Degree: BACHELOR'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2020). (Compulsory subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Catalan

LECTURER

Coordinating lecturer: CAROLINA PUIG POLO

Others: CAROLINA PUIG POLO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14446. Solve mathematical problems that may arise in engineering by applying knowledge about: linear algebra, geometry, differential geometry, differential and integral calculus, optimization, ordinary differential equations.
14447. Obtain basic knowledge about the use and programming of computers, operating systems, databases and basic numerical calculation and applied to engineering.
14448. Manage the basic concepts about the general laws of mechanics and thermodynamics, concept of field and heat transfer, and apply them to solve engineering problems.
14450. Describe the global functioning of the planet: atmosphere, hydrosphere, lithosphere, biosphere, anthroposphere, biogeochemical cycles (C, N, P, S), soil morphology and apply it to problems related to geology, geotechnics, edaphology and climatology.
14453. Describe and apply the techniques of analysis of physical, chemical and biological parameters; Integrate the experimental evidence found in field and / or laboratory data with the theoretical knowledge and interpret its results.
14457. Identify the fundamentals of structure theory, sustainable procedures for construction and dismantling of buildings and civil works; and describe the technology bases of the materials used in construction.
14458. Apply the methodologies of studies and evaluations of environmental impact and, in general, of environmental technologies, sustainability and waste treatment and of the management of international standards of environmental quality. Life cycle analysis, carbon footprint and water footprint and assess natural hazards (river, coastal floods, droughts, fires, soil erosion and landslides).
14459. Describe the components and modes of transport and the impact of their externalities on the environment; identify the principles of environmental management of transport systems and sustainable planning of the territory; and introduce the tools for the management and operation of transport systems.
14461. Analyze, design, simulate and optimize processes and systems with environmental relevance, both natural and artificial, and their resolution techniques, as well as recognize techniques for analysis and evaluation of climate change.
14465. Identify renewable energy generation techniques and energy transition concept.

Generical:
14440. Identify, formulate and solve problems related to environmental engineering.
14441. Apply the functions of consulting, analysis, design, calculation, project, construction, maintenance, conservation and exploitation of any action in the territory in the field of environmental engineering.
14442. To use in any action in the territory proven methods and accredited technologies, in order to achieve the greatest efficiency respect for the environment and the protection of the safety and health of workers and users.

TEACHING METHODOLOGY

The course consists of 2.3 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 2.3 hours in the large size groups are devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 1.2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students. The objective of these practical exercises is to consolidate the general and specific learning objectives.

The rest of weekly hours devoted to laboratory practice.

Support material in the form of a detailed teaching plan is provided using the virtual campus ATENEA: content, program of learning and assessment activities conducted and literature.

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.

LEARNING OBJECTIVES OF THE SUBJECT

Satellite, aerial, terrestrial sensors. Punctual instrumentation vs. distributed detection. Point sensors in rivers and territory. Sensor networks. Weather networks. Statistical techniques for processing data series. Passive and Active Remote Sensing (Radar and others). Multispectral and hyperspectral sensors, combination of bands. Satellite missions of interest, Organizations / companies producing R.S. Relationship between TD and climate change. TD Applications in Environmental Engineering. Big Data.

1. Know the systems and methods of collecting environmental data: physical, chemical sensors, remote sensing.
2. Understand the concepts of passive and active remote sensing and know the main existing sensors, as well as the largest satellite missions interest.
3. Apply environmental data management tools: statistical techniques and visualization using GIS.

Instrumentation, Remote Sensing and Big Data. Introduction to the systems and methods of collecting environmental data (atmosphere, inland, sewage and marine waters, soils): concept of active and passive remote sensing and description of the main satellite missions and other data collection systems.
Study of the main statistical techniques for the treatment and management of the data series obtained.

STUDY LOAD

Type	Hours	Percentage
Self study	90,0	60.00
Hours large group	30,0	20.00
Hours medium group	15,0	10.00
Hours small group	15,0	10.00

Total learning time: 150 h

CONTENTS

1. Introduction to

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

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

2. Physical Principles of Remote Sensing

Description:
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
THE B. Visualization of satellite images

Full-or-part-time: 12h
Theory classes: 2h
Laboratory classes: 3h
Self study : 7h

3. Platforms and Sensors

Description:
Types of resolution: spatial, spectral, radiometric and temporal. Passive sensors. Active sensors.
Landsat program. Copernicus Program. High resolution commercial space satellites.

Full-or-part-time: 12h
Theory classes: 5h
Self study : 7h

4. Analysis and Image Interpretation

Description:
Spectral index
Indices of vegetation, water and burned area with images inside the optician.
Ice and snow spectral indices
Concept of supervised and unsupervised classification. Unsupervised classification type. Type of supervised classification.
Unsupervised classification
Supervised classification

Full-or-part-time: 40h 48m
Theory classes: 6h
Laboratory classes: 11h
Self study : 23h 48m

5. Remote sensing at microwave frequency

Description:
Radar Effects of frequency, polarization, angle of incidence and humidity Radar section, radar equation, speckle Real Aperture Radar Geometric effects of radar images The Synthetic Aperture Radar SAR Radial and azimuthal resolution. Slant-range and ground-range Doppler effect Amplitude images
SAR polarimetry
DinSAR

Full-or-part-time: 19h 12m
Theory classes: 4h
Laboratory classes: 4h
Self study : 11h 12m

6. Remote Sensing Applications

Description:
Applications of remote sensing to agriculture
Floods, volcanoes, earthquakes, droughts, fires, ...
Remote sensing applied to natural hazards

Full-or-part-time: 21h 36m
Theory classes: 5h
Laboratory classes: 4h
Self study : 12h 36m

7. Instrumentation and Remote Sensing

Description:
Instruments for marine and inland waters
extensometers, clinometers * In probing: extensometers, inclinometers, sliding probes, piezometers. Cable extensometer.

Full-or-part-time: 14h 23m
Theory classes: 6h
Self study : 8h 23m

8. Big Data and Remote Sensing

Description:
Theory, methods and applications
LAB: Remote Sensing and Big Data. Google Earth Engine.

Full-or-part-time: 19h 12m
Theory classes: 4h
Laboratory classes: 4h
Self study : 11h 12m

GRADING SYSTEM

This subject is approved by Continuous Learning and Assessment (AAC). The Rating Method is summarized below. Additional details of the method will be given on the first day of class. # The ordinary grade for the subject is obtained from the continuous assessment grades, which consist of three types of grades: - Ne: exam grades. Two tests with a similar weight. - Nlab: laboratory grade and - NTre: work grade The final grade (NF) of the subject is calculated as: NF=40%*Ne + 30%Nlab + 30%NTre It will be detailed in the Athena of the subject the weight of each of the deliveries of the practices. Each internship delivery must be made within the indicated period, late deliveries will not be accepted without just cause and notification prior to the maximum delivery date. # Criteria for qualification and admission to re-evaluation: Students who have failed the ordinary evaluation and who have regularly taken the evaluation tests for the subject and who have attended practical sessions sufficiently (>80%), will have the option to take a test of reevaluation in the period established in the academic calendar. In this test, the theory part of the subject and the practical part that corresponds to the laboratories will be evaluated. The students who have already passed it, nor the students qualified as not presented, will not be able to present themselves to the re-evaluation test of the subject. The maximum grade in the case of taking the reevaluation exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held in the established period, may not give rise to another test with a later date.

EXAMINATION RULES.

If any of the laboratory or continuous assessment activities are not performed in the scheduled period, it will be considered a zero score.

BIBLIOGRAPHY

Basic:

- Chuvieco Salinero, Emilio; Huete, Alfredo. Fundamentals of satellite remote sensing. Boca Raton [etc.]: Taylor & Francis, 2010. ISBN 9780415310840.
- Woodhouse, Iain H. Introduction to microwave remote sensing. Boca Raton: Taylor & Francis, 2006. ISBN 0415271231.