Course guides
2500033 - GECSINGETE - Gis and Remote Sensing

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

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Optional subject).

Academic year: 2020 ECTS Credits: 4.5 Languages: Catalan, Spanish

LECTURER

Coordinating lecturer: MARIA DE LAS NIEVES LANTADA ZARZOSA
Others: MARIA DE LAS NIEVES LANTADA ZARZOSA, CAROLINA PUIG POLO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONtributes

Specific:
14406. Ability to analyze the problem of safety and health in construction sites. (Common module to the Civil branch)
14410. Knowledge of the typology and calculation bases of prefabricated elements and their application in manufacturing processes. (Specific technology module: Civil Construction)
14411. 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)
14413. 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)
14414. 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)
14415. Ability to apply construction procedures, construction machinery and construction planning techniques. (Specific technology module: Civil Construction)
14416. Capacity for the construction of geotechnical works. (Specific technology module: Civil Construction)

TEACHING METHODOLOGY

The course consists of 1.5 hours per week of classroom activity (large size group) and 1.2 hours weekly with half the students (medium size group).

The 1.5 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.
LEARNING OBJECTIVES OF THE SUBJECT

- Database. Data introduction and query in GIS. Spatial, vector and raster analysis. 3D information management (Digital terrain models).

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.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guided activities</td>
<td>4,5</td>
<td>4.00</td>
</tr>
<tr>
<td>Self study</td>
<td>63,0</td>
<td>56.00</td>
</tr>
<tr>
<td>Hours medium group</td>
<td>18,0</td>
<td>16.00</td>
</tr>
<tr>
<td>Hours small group</td>
<td>4,5</td>
<td>4.00</td>
</tr>
<tr>
<td>Hours large group</td>
<td>22,5</td>
<td>20.00</td>
</tr>
</tbody>
</table>

Total learning time: 112.5 h

CONTENTS

**General concepts of Geographic Information Systems (GIS).**

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

**Specific objectives:**
Give the student an overview of the subject Introduction to the basic fundamentals of Geographic Information Systems

**Full-or-part-time:** 4h 48m
Theory classes: 2h
Self study: 2h 48m
Geoinformation or geographic information (GI)

Description:
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 and ᵃ renaming.
Exercises for changing image header file formats, from raster to vector and from vector to raster.
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)

Full-or-part-time: 16h 48m
Theory classes: 2h
Practical classes: 1h
Laboratory classes: 4h
Self study : 9h 48m

Database

Description:
Structuring information in GIS. Union of thematic information to GIS maps. Creation and calculation of geo-attributes with the geometry of geographic entities (area, perimeter, length, centroid coordinates, etc.) SQL queries and selection of entities by attributes of the information associated with maps.

Specific objectives:
Organize information in an optimized and related way in a relational database, and make inquiries in it later.

Full-or-part-time: 7h 11m
Theory classes: 1h
Practical classes: 2h
Self study : 4h 11m
Sources and acquisition of spatial data. Remote sensing

Description:
Explanation of the basic operation for the visualization of spatial information and metadata using several different GIS tools. Data infrastructures. Inspire regulations and OGC services: WMS, WFS, WCS Application of geomatic techniques (GNSS / GPS, LIDAR, photogrammetry, remote sensing, etc.), which provide layers with geoinformation to GIS
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.
Creating tables, fields and relationships. Geo-attribute calculation Integration of information into GIS Creating relationships between maps and the database Visualization of information spatially

Specific objectives:
Optimal search of geospatial data from data catalogs, using metadata and connection through GIS programs to the cartography offered by the services of the Open Geospatial Consortium (OGC): WMS, WFS and WCS. Integrate layers from different sources and formats into the GIS project and visualize open data
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.
Integrate layers from different data sources into the GIS (GPS, satellite, LIDAR, etc.).
GPS data capture in DGPS mode to create an inventory of events in the field, with associated information. Design and creation of the database, and its integration in the GIS for its subsequent spatial visualization and its management in the GIS

Full-or-part-time: 28h 47m
Theory classes: 4h
Practical classes: 3h
Laboratory classes: 5h
Self study : 16h 47m

3D information management

Description:
Creation and visualization of digital models of elevations and digital terrain models in vector format (TIN) and raster (GRID)
Creation and visualization of digital terrain models in raster format and 3D surfaces in TIN formwork. Interpolation methods.
Creation of maps derived from digital elevation models such as: slope maps, orientation, curvature, roughness, drainage network, river basins or watersheds, and viewsheeds.

Specific objectives:
From 3D information in different formats create a 3D surface or a digital model of the raster terrain. 3D visualization of information. Transfer the elevation of the terrain to 2D entities

Full-or-part-time: 14h 23m
Theory classes: 2h
Laboratory classes: 4h
Self study : 8h 23m
Geoprocessing or spatial analysis

Description:
GIS tools and techniques for combining vector maps and rasters: connectivity, proximity, inclusion.
Vector and raster spatial analysis tools with different quantitative or qualitative variables, which were necessary for decision making.
Identification of sinks and their correction to the digital model of the terrain.
Creating flow direction and flow accumulation models
Obtaining the hierarchical drainage network and hydrological basins
Starting from some initial maps and tables, pose a problem to obtain certain information or derived maps that serve as a basis for decision making.

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

Full-or-part-time: 36h
Theory classes: 4h
Practical classes: 7h
Laboratory classes: 4h
Self study: 21h

GRADING SYSTEM

The mark of the course is obtained from the ratings of continuous assessment and their corresponding laboratories and/or classroom computers.

Continuous assessment consist in several activities, both individually and in group, of additive and training characteristics, carried out during the year (both in and out of the classroom).

The teachings of the laboratory grade is the average in such activities.

The evaluation tests consist of a part with questions about concepts associated with the learning objectives of the course with regard to knowledge or understanding, and a part with a set of application exercises.

EXAMINATION 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.

BIBLIOGRAPHY

Basic:

Complementary: