Course guides
250808 - 250808 - Geographic Information Systems

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.
Degree: MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Optional subject).
Academic year: 2020 ECTS Credits: 5.0 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

Generical:
13300. To apply advanced knowledge in sciences and technology to the professional or research practice.
13302. To identify and design solutions for geo-engineering problems within ethical, social and legislative frameworks.
13303. To evaluate the impact of Geo-engineering on environment, sustainable social development and the significance of working within reliable and conscienous professional environment.
13304. To incorporate new tecnologies and advanced tools in Geo-engineering into profesional and research activities.
13305. To conceive Geo-engineering as a multi-disciplinary field that includes relevant aspects from geology, sismology, hydrogeology, geotechnical and earthquake engineering, geomechanics, physics of porous media, geophysics, geomatics, natural hazard, energy and climate interactions.
13306. To promote innovation for the development of methodology, analyses and solutions in Geo-engineering

TEACHING METHODOLOGY

The course consists of 3 hours per week of classroom activity.

The 1 hour in the large size groups is devoted to theoretical lectures, in which the teacher presents the basic concepts and topics of the subject, shows examples and solves exercises.

The 2 hours in the medium size groups is devoted to solving practical problems with greater interaction with the students (in general in a classroom with computers and software necessary to the subject practice). 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

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
To interpret laboratory tests and field observations so as to identify the mechanisms responsible for soil response. To propose laboratory testing programmes.
To formulate and implement Finite Element and Finite Differences numerical models with the objective to analyze the processes that govern ground response, to interpret field information and to predict soil response.

* To apply oral presentation techniques.
* To use advanced calculation tools to analyze Civil Engineering problems, design big-scale models and suggest design solutions for prototypes.
* To know and be able to use advanced techniques to geo-referentially represent data.
* To have powerful tools for the geospatial analysis of geo-referentiated data.

- Introduction to GIS.
- Structures of data: vector and raster formats.
- New technologies for data capture.
- Georeferencing.
- Metadata.
- Topology errors and editing data.
- Database.
- Spatial analysis and digital terrain models.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Theory classes</td>
<td>19.5</td>
<td>15.59</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6.0</td>
<td>4.80</td>
</tr>
<tr>
<td>Laboratory classes</td>
<td>9.8</td>
<td>7.83</td>
</tr>
<tr>
<td>Self study</td>
<td>80.0</td>
<td>63.95</td>
</tr>
<tr>
<td>Practical classes</td>
<td>9.8</td>
<td>7.83</td>
</tr>
</tbody>
</table>

Total learning time: 125.1 h

CONTENTS

Spatial Data Infrastructure (SDI)

Description:

Several kind of cartography and metadata, located on remote servers, will be displayed through a WMS from a GIS program.

Specific objectives:

To use browsers and GIS tools to search geographic information. Edit its metadata, and assign or change its cartographic reference system
Search and download maps on the web, through catalogs and Web services

Full-or-part-time: 7h 11m
Theory classes: 1h
Laboratory classes: 2h
Self study: 4h 11m
### Data structure

**Description:**
Data structures: vector, raster, 3D and network
Description of concepts and GIS files with graphic and alphanumeric information with different data structures.

**Specific objectives:**
To know files and data format of the model vector, raster and 3D. Make conversions formats. 
Open maps in different formats and structures programs SIG

**Full-or-part-time:** 24h  
Theory classes: 6h  
Laboratory classes: 4h  
Self study : 14h

### Global Navigation Satellite System

**Description:**
DGPS or GPS for GIS

**Specific objectives:**
Measuring elements enters a GNSS receiver in GIS format, with attributes associated with the method differential GPS (DGPS). 
Managing this information in a GIS tool for future reference and use.

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

### Other sensors of Earth observation

**Description:**
Description techniques of remote sensing by satellite or airborne platform
Description instrumentation, types and details  
Treatment of satellite images from different sensors and times with GIS software

**Specific objectives:**
Introduce other methods of obtaining geographic information, which can be built and managed in a GIS  
Know the options and applications of laser scanner instrumentations.  
To generate DTM from LIDAR point cloud  
Using image processing software with GIS

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

**Description:**
Spatial Analysis or Geoprocessing (raster, vectorial and whit DTM)
Spatial Analysis (raster and vector MDT)

**Specific objectives:**
Combine maps of various formats for response to a specific problem or take decisions. Perform simulations of events. Generate new spatial information from maps available.

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

Projects and GIS applications

**Description:**
Diagram Design GIS workflow tool for solving problems in real projects.

**Specific objectives:**
Knowing the database tools, analysis and design conversión que allow the optimum workflow to solve specific problems in GIS

**Full-or-part-time:** 16h 48m
- Practical classes: 5h
- Laboratory classes: 2h
- Self study: 9h 48m

**GRADING SYSTEM**

The rating will be obtained from the continuous assessment marks: 1) Note exams (Ne): the mean of two individual written assessment test (at the middle and the end of the semester) theoretical concepts associated objectives learning course regarding knowledge or understanding. 2) Note of practical activities (Np): problems and practice both individual and group training and additive nature, made during the year (in the classroom and outside of it). The Np will be elaborated by an average (weighted by the importance of each activity); in general Np will be: the GIS project (70%)+ DGPS or GPS for GIS (15%)+ Remote Sensing (10%)+LIDAR and others (5%).

Final grade NF is: \( Nf = Ne \times 0.25 + 0.75 \times Np \).

**EXAMINATION RULES.**

Deliveries of continuous assessment activities (field and some of the laboratory) out of the scheduled period will result in a mark of zero in that activity. The attendance to the DGPS for GIS field practice is mandatory.

**BIBLIOGRAPHY**

**Basic:**

**Complementary:**