Course guides
250835 - 250835 - Static and Dynamic Structural Analysis

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, English

LECTURER
Coordinating lecturer: MARCOS ARROYO ALVAREZ DE TOLEDO
Others: MARCOS ARROYO ALVAREZ DE TOLEDO, JOSE RAMON GONZALEZ DRIGO

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
13308. To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
13312. To analyze, discriminate and integrate geological and geotechnical information in studies and projects.
13317. To dimension civil structures in the presence of seismic forces. To dimension corrective solutions. (Specific competence of the specialization in Earthquake Engineering and Geophysics).
13318. To assess seismic risks. To plan and dimension risk reduction measures. (Specific competence of the specialization in Earthquake Engineering and Geophysics).
13324. To identify all types of structures and materials. To design, plan, implement and maintain structures and buildings in civil works. (Specific competence of the specialization in Earthquake Engineering and Geophysics).
13325. To analyze the structures, by applying advanced methods, design software and structural calculations, from the knowledge and understanding of the forces and their application to the structural typologies used of civil engineering. To perform structural integrity assessment. (Specific competence of the specialization in Earthquake Engineering and Geophysics).

Generical:
13300. To apply advanced knowledge in sciences and technology to the profesional or research practice.
13301. To lead, coordinate and develop integrated projects in Geo-Engineering.
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 conscious professional environment.
13304. To incorporate new technologies 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.
13307. To tackle and solve advanced mathematical problems in engineering from the drafting of the problem to the development of formulation and further implementation in computer programs. Particularly, to formulate, code and apply analytical and numerical advanced computational tools to project calculations in order to plan and manage them as well as to interpret results in the context of Geo-engineering and Mining engineering.
TEACHING METHODOLOGY

The course consists of 3 hours per week of classroom activity (large size group).

The 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.

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 analyze, discriminate and integrate geological and geotechnical information in studies and projects.
To dimension civil structures in the presence of seismic forces. To dimension corrective solutions. (Specific competence of the specialization in Earthquake Engineering and Geophysics).
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To identify all types of structures and materials. To design, plan, implement and maintain structures and buildings in civil works. (Specific competence of the specialization in Earthquake Engineering and Geophysics).
To analyze the structures, by applying advanced methods, design software and structural calculations, from the knowledge and understanding of the forces and their application to the structural typologies used of civil engineering. To perform structural integrity assessment. (Specific competence of the specialization in Earthquake Engineering and Geophysics).

* To have the basic and advanced knowledge on linear or non-linear structural analysis.
* To know and be able to deal with the different types of structures significant in earthquake engineering.
* To know the methods and techniques for active and passive vibration control in buildings.
* To know and apply advanced techniques on the use of especial and composed materials.
* To have a global vision on how to address the main problems regarding the dynamic response of buildings and structures.
* To know and apply the main regulation on seismoresistant design and construction.

- Matrix analysis of structures.
- Plastic Analysis of structure and plate theory.
- Systems of one degree of freedom.
- Systems of n degrees of freedom.
- Seismic response and design of multi-levels buildings.
- Computational programs and structural analysis.

STUDY LOAD

<table>
<thead>
<tr>
<th>Type</th>
<th>Hours</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hours medium group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Guided activities</td>
<td>6,0</td>
<td>4.80</td>
</tr>
<tr>
<td>Hours large group</td>
<td>19,5</td>
<td>15.59</td>
</tr>
<tr>
<td>Hours small group</td>
<td>9,8</td>
<td>7.83</td>
</tr>
<tr>
<td>Self study</td>
<td>80,0</td>
<td>63.95</td>
</tr>
</tbody>
</table>

Total learning time: 125.1 h
## Statics of structures

**Description:**
INTRODUCTION TO THE STRUCTURAL ANALYSIS

**Specific objectives:**
Acquire knowledge, ability and competence for structural design of simple structural systems and for handling numerical calculation codes oriented linear and nonlinear calculation of conventional structures

**Full-or-part-time:** 19h 12m  
Theory classes: 8h  
Self study : 11h 12m

## Plastic calculation of structures

**Description:**
PLASTIC ANALYSIS dimensional bar structures Plasticity. Moment resistant plastic. Structures subjected to tension rods. Porticoes and dominant bending beams forming plastic hinges.

**Specific objectives:**
Acquire knowledge, ability and competence for structural design of simple structural systems and for handling numerical calculation codes oriented linear and nonlinear calculation of conventional structures

**Full-or-part-time:** 7h 11m  
Theory classes: 3h  
Self study : 4h 11m

## Plate theory

**Description:**

**Specific objectives:**
Acquire knowledge, ability and competence for structural design of simple structural systems and for handling numerical calculation codes oriented linear and nonlinear calculation of conventional structures

**Full-or-part-time:** 7h 11m  
Theory classes: 3h  
Self study : 4h 11m
estructuras dynamic calculation. systems one degree of freedom

Description:

Specific objectives:
Acquire knowledge, ability and competence for the design and management of numerical calculation codes for solving linear and nonlinear problems in the field of earthquake engineering and structural dynamics.

Full-or-part-time: 19h 12m
Theory classes: 8h
Self study : 11h 12m

estructuras dynamic calculation. systems N degrees of freedom

Description:
STRUCTURES N degrees of freedom. SHEAR BUILDING matrix formulation of the equations of motion for shear buildings Free Vibrations Vibrations in buildings shear shear forced into buildings. Damping modal superposition method in buildings Reduction shear dynamic arrays multigrade SYSTEMS DISCREET OF FREEDOM dynamic analysis of beams and plane frames analysis response time. Stepper methods modeled DISTRIBUTED PROPERTIES dynamic characteristic analysis systems Discretization of continuous systems Structure project

Specific objectives:
Acquire knowledge, ability and competence for the design and management of numerical calculation codes for solving linear and nonlinear problems in the field of earthquake engineering and structural dynamics

Full-or-part-time: 40h 48m
Theory classes: 9h
Laboratory classes: 8h
Self study : 23h 48m

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.

Failure to perform a laboratory or continuous assessment activity in the scheduled period will result in a mark of zero in that activity.
BIBLIOGRAPHY

Basic: