250800 - Continuum Mechanics

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2019
Degree: MASTER'S DEGREE IN GEOTECHNICAL ENGINEERING (Syllabus 2015). (Teaching unit Compulsory)
ECTS credits: 5
Teaching languages: Spanish

Teaching staff

Coordinator: FRANCISCO JAVIER SANCHEZ VILA
Others: FRANCISCO JAVIER SANCHEZ VILA

Degree competences to which the subject contributes

Specific:
13308. To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.

General:
13300. To apply advanced knowledge in sciences and technology to the professional or research practice.
13301. To lead, coordinate and develop integrated projects in Geo-Engineering.
13304. To incorporate new technologies and advanced tools in Geo-engineering into professional 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 subject consists of 4 hours per week of classroom lessons in the classroom (large group)

Each class combines theoretical knowledge with a large number of learning exercises to work individually or in groups.

Support material is used in the format of a detailed teaching plan through the ATENEA virtual campus: contents, programming of assessment activities and directed learning and bibliography.

Learning objectives of the subject

To conceive soils and rocks as porous media governed by Solid and Fluid Mechanics.
To characterize the geological environment and its interaction with civil works.
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
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processes that govern ground response, to interpret field information and to predict soil response.

- To recognize the problems in Civil Engineering.
- To relate the problems in Civil Engineering to the characteristics of the geological environment.
- To conceptualize the problem in Civil Engineering in order to analyze, model and solve them.
- To apply continuum media concepts to analyze and model problems in Civil Engineering.
- To apply numerical techniques to solve Civil Engineering problems.

- Continuum in soils and rocks. Eulerian and Lagrangian description.
- Elements of Solid Mechanics. Linear elasticity.
- Fluid mechanics.

Study load

<table>
<thead>
<tr>
<th>Total learning time: 125h</th>
<th>Theory classes: 19h 30m</th>
<th>15.60%</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Practical classes: 9h 45m</td>
<td>7.80%</td>
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<tr>
<td></td>
<td>Laboratory classes: 9h 45m</td>
<td>7.80%</td>
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<tr>
<td></td>
<td>Guided activities: 6h</td>
<td>4.80%</td>
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<tr>
<td></td>
<td>Self study: 80h</td>
<td>64.00%</td>
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</tbody>
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## Content

### Mathematics and physics concepts

<table>
<thead>
<tr>
<th>Learning time: 31h 12m</th>
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<tbody>
<tr>
<td>Theory classes: 8h</td>
</tr>
<tr>
<td>Practical classes: 2h</td>
</tr>
<tr>
<td>Laboratory classes: 3h</td>
</tr>
<tr>
<td>Self study: 18h 12m</td>
</tr>
</tbody>
</table>

**Description:**
- Differential operators: Del operator, Gradient, divergence and Laplacian in Cartesian and cylindrical coordinates.
- Integrals in space. Derivation under the integral sign. Integral theorems. Special functions: Heavyside and Dirac
- Ordinary differential equations: ODE of separable, homogeneous and linear variables of constant coefficients.
- Resolution of PDEs. Transformed by Laplace and Fourier
- Solving exercises on ODEs and PDEs

### Description of movement

<table>
<thead>
<tr>
<th>Learning time: 16h 48m</th>
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<tbody>
<tr>
<td>Theory classes: 4h</td>
</tr>
<tr>
<td>Practical classes: 3h</td>
</tr>
<tr>
<td>Self study: 9h 48m</td>
</tr>
</tbody>
</table>

**Description:**
- Equations of movement. Exercises

### Stress-strain

<table>
<thead>
<tr>
<th>Learning time: 45h 36m</th>
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<tbody>
<tr>
<td>Theory classes: 10h</td>
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<tr>
<td>Practical classes: 5h</td>
</tr>
<tr>
<td>Laboratory classes: 4h</td>
</tr>
<tr>
<td>Self study: 26h 36m</td>
</tr>
</tbody>
</table>

**Description:**
- Description of the deformation tensor. Hooke's law. Elasticity and plasticity
- Lineal elasticity. Plasticity
- Exercises on stress and strain
The qualification of the subject is obtained based on the continuous assessment qualification.

The continuous assessment consists in doing different activities, individual and group, of an additive and formative nature, carried out during the course (inside and outside the classroom).

Evaluation tests consist of a set of application exercises

### Regulations for carrying out activities

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

### Bibliography

**Basic:**