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# Course guide
## 250800 - 250800 - Continuum Mechanics

**Last modified:** 25/01/2024

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| **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). (Compulsory subject).

**Academic year:** 2023    **ECTS Credits:** 5.0    **Languages:** Spanish

## LECTURER

**Coordinating lecturer:** FRANCISCO JAVIER SANCHEZ VILA

**Others:** FRANCISCO JAVIER SANCHEZ VILA, MICHELE STARNONI

## 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.

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

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 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.

- Advanced mathematical concepts. Element of vector calculus and differential equations.
- Continuum in soils and rocks. Eulerian and Lagrangian description.
- Elements of Solid Mechanics. Linear elasticity.
- Fluid mechanics.

## STUDY LOAD

| Type | Hours | Percentage |
|------|-------|------------|
| Hours small group | 9,8 | 7.83 |
| Self study | 80,0 | 63.95 |
| Hours large group | 25,5 | 20.38 |
| Hours medium group | 9,8 | 7.83 |

**Total learning time:** 125.1 h

## CONTENTS

### Mathematics and physics concepts

**Description:**
Concepts of vectors and tensors. Definitions of fields. Derivation Changes in coordinates. Eigenvalues and eigenvectors
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

**Full-or-part-time:** 36h
Theory classes: 8h
Practical classes: 5h
Laboratory classes: 2h
Self study : 21h

### Description of movement

**Description:**
Equations of movement. Descriptions Euleriana and Lagrangiana. Concept of material derivative. Balancing equations.
Equations of movement. Exercises

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

### Stress-strain

**Description:**
Mechanics of the solid. Constitutive equations. Tensions and deformations. Mohr's circle.
Description of the deformation tensor. Hooke's law. Elasticity and plasticity
Lineal elasticity. Plasticity
Exercises on stress and strain

**Full-or-part-time:** 50h 24m
Theory classes: 12h
Practical classes: 6h
Laboratory classes: 3h
Self study : 29h 24m

## GRADING SYSTEM

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

## EXAMINATION RULES.

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

## BIBLIOGRAPHY

**Basic:**

- Oliver Olivella, X.; Agelet de Saracíbar, C. Mecánica de medios continuos para ingenieros [on line]. 2a ed. Barcelona: Edicions UPC, 2002 [Consultation: 10/05/2021]. Available on: http://hdl.handle.net/2099.3/36197. ISBN 848301582X.