250121 - MECMEDCON - Continuum Mechanics

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering
Academic year: 2018
Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2010). (Teaching unit Compulsory)
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Teaching unit Compulsory)
ECTS credits: 9 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: FRANCISCO JAVIER OLIVER OLIVELLA

Others: CARLOS AGELET DE SARACIBAR BOSCH, ORIOL LLOBERAS VALLS, JULIO MARTÍ, FRANCISCO JAVIER OLIVER OLIVELLA

Opening hours

Timetable: Office hours to be arranged with the lecturers of the course.

Degree competences to which the subject contributes

Specific:

3026. Ability to analyse and understand how the characteristics of structures influence their behaviour. Ability to apply knowledge of the resistance dynamics of structures in order to dimension them in accordance with existing regulations using analytical and numerical calculation methods.
3028. Understanding and mastery of the laws of thermodynamics of continuous media and the ability to apply them in the fields of engineering such as fluid mechanics, material mechanics, structures theory, etc.

Transversal:

592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
596. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
599. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

Teaching methodology

The course consists of 6 hours a week of on-campus classes taught in two-hour lectures. These lectures will combine theory and problems. Additionally, students will be given assignments they must perform on their own to consolidate the general and specific learning objectives.

For the group in english the course uses the "flipped classroom" methodology where the student, by means of specific group-dynamics techniques, extends and consolidates the knowledge acquired during the out-of-class preparation, in advance, of basic elements corresponding the following classes. The out-of-class preparation is carried out by the student, supported by videos, transparencies, books and bibliographic material, provided on the website of the course, and according to the directions of the teacher. Then, the in-class group dynamics consists of providing the group of students the required additional knowledge, according to the possible weaknesses identified by the teacher, perform practical exercises, answer questions, deepen the students knowledge on the subject and promote teamwork.

Learning objectives of the subject

Students will acquire an understanding of the laws of thermomechanics of continuous media and learn to apply them in engineering-related areas, such as fluid mechanics, mechanics of materials, structural theory, etc.

Upon completion of the course, students will have acquired the ability to: 1. Describe movement, deformations and stresses. 2. Apply conservation equations to structural, hydraulic and geotechnical problems. 3. Develop and understand behavioural models of both solid and fluid materials.

History of the mechanics of continuous media in the context of civil engineering; Description of motion, including Lagrangian and Eulerian formulations; Deformation of a continuous medium and compatibility equations; Motion and deformation in cylindrical and spherical coordinate systems; Cauchy's stress principle, postulates and equations; Analysis of stress states using Mohr's circle; Equations of conservation of mass, momentum and energy; Thermodynamics of continuous media; Fundamental concepts of constitutive equations; Theory of elasticity, plasticity, failure criteria and viscoplasticity; Principle of virtual work; Constitutive behaviour of fluids; Fluid mechanics; Equations of motion; Turbulence

Provide the student with a comprehensive and unified vision of deformable Solid Mechanics and Fluid Mechanics in engineering. Provide specific expertise which may be used in other disciplines (Structural Analysis, Soil Mechanics, Hydraulics, Hydrodynamics, etc.).

Study load

Total learning time: 225h	Theory classes:	50h	22.22%
	Practical classes:	28h	12.44%
	Laboratory classes:	12h	5.33%
	Guided activities:	9h	4.00%
	Self study:	126h	56.00%

Content

Introduction	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
Description: Introduction to the course and review of tensor algebra.	

Description of Motion	Learning time: 15h 36m Theory classes: 4h Practical classes: 2h 30m Self study : 9h 06m
Description: Theory Problems	

Deformation and Strain	Learning time: 25h 12m Theory classes: 8h Practical classes: 2h 30m Self study : 14h 42m
Description: Theory Problems	

Compatibility Equations	Learning time: 12h Theory classes: 2h Practical classes: 1h Laboratory classes: 2h Self study : 7h
Description: Theory Problems	

Stress	Learning time: 24h Theory classes: 8h Practical classes: 2h Self study : 14h
Description: Theory Problems	

Conservation and Balance Equations	Learning time: 36h Theory classes: 9h Practical classes: 4h Laboratory classes: 2h Self study : 21h
Description: Theory Problems	

Linear Elasticity	Learning time: 30h Theory classes: 8h Practical classes: 4h 30m Self study : 17h 30m
Description: Theory Problems	

Plane Linear Elasticity	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
Description: Theory	

Plasticity	Learning time: 27h 36m Theory classes: 5h 30m Practical classes: 4h Laboratory classes: 2h Self study : 16h 06m
Description: Theory Problems	

Constitutive Equations in Fluids	Learning time: 4h 48m Theory classes: 2h Self study : 2h 48m
Description: Theory	

Fluid Mechanics	Learning time: 21h 36m Theory classes: 6h Practical classes: 3h Self study : 12h 36m
Description: Theory Problems	

Variational Principles	Learning time: 9h 36m Theory classes: 2h Laboratory classes: 2h Self study : 5h 36m
Description: Theory	

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Qualification system

The evaluation of the course will be made from two grades:
a) A grade based on the performance of test, multiple-question type. Four tests, on contents grouped by topics of the course, will be made. These tests will be about one hour long, and will be done along the course. The final mark of the assessment will result into a "mid-terms evaluation mark" (NAP) to be obtained as a combination of the arithmetic average (with a weight of 0.9) and the geometric average (with a weight of 0, 1) of partial evaluations, on 10 points.
b) A grade based on individual perception, by the lecturer, about the "global" knowledge of the subject by each student, the involvement in the learning dynamics proposed in classes and the group-work skills acquired over the course. This assessment will be done on the basis of the continuous in-class lecturer-students interaction throughout the course and the final perception of the lecturer. The grading will result in a "teacher's perception mark" (NP) on 10 points.
The final mark (NF) will be weighted between the two marks as
NF=max(NAP; 0.8*NAP+0.2*NP) rounded to the lower multiple of 0.1.
To pass the course, the student will need to obtain a mark (NF) equal to or greater than 5

Criteria for re-evaluation qualification and eligibility: Students that failed the ordinary evaluation and have regularly attended all evaluation tests will have the opportunity of carrying out a re-evaluation test during the period specified in the academic calendar. Students who have already passed the test or were qualified as non-attending will not be admitted to the re-evaluation test. The maximum mark for the re-evaluation exam will be five over ten (5.0). The non-attendance of a student to the re-evaluation test, in the date specified will not grant access to further re-evaluation tests. Students unable to attend any of the continuous assessment tests due to certifiable force majeure will be ensured extraordinary evaluation periods.

These tests must be authorized by the corresponding Head of Studies, at the request of the professor responsible for the course, and will be carried out within the corresponding academic period.

Regulations for carrying out activities

If any of the ongoing evaluation activities are not performed in the scheduled period a zero mark will be assigned to that activity.

In case of failure to attend an assessment test due to a justifiable reason, the student must notify the professor in charge of the course BEFORE OR IMMEDIATELY AFTER THE TEST and hand in an official certificate excusing his absence. In this case, the student will be allowed to take the test another day, ALWAYS BEFORE THE FOLLOWING ASSESSMENT.

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Bibliography

Basic:

Oliver Olivella, X.; Agelet de Saracíbar, C. Mecànica de medis continus per a enginyers. Barcelona: Edicions UPC, 2003. ISBN 8483017199.

Oliver Olivella, X.; Agelet de Saracíbar, C. Mecánica de medios continuos para ingenieros. 2a ed. Barcelona: Edicions UPC, 2002. ISBN 848301582X.

Oliver, X.; Agelet de Saracíbar, C. Problemas de mecánica de medios continuos. Barcelona: CPET, 2004.

Complementary:

Chaves, E.W.V. Notes on continuum mechanics. Barcelona: Springer : CIMNE, 2013. ISBN 9789400759855.

Chaves, E.W.V.. Mecánica del medio continuo : conceptos básicos. 3a ed. Barcelona: CIMNE, 2012. ISBN 9788494024382.

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Fung, Y. K. Foundations of solid mechanics. Englewood Cliffs, NJ: Prentice-Hall, 1965.

Holzapfel, G.A. Nonlinear solid mechanics : a continuum approach for engineering. Chichester: Wiley & Sons, 2008. ISBN 0471823198.

Malvern, L.E. Introduction to the mechanics of a continuous medium. Englewood Cliffs, NJ: Prentice-Hall, 1969. ISBN 0134876032.

Spencer, A.J.M. Continuum mechanics. Mineola: Dover Publications, 2004. ISBN 0486435946.