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250401 - MECMEDCON - Mechanics of Continua

Coordinating unit: 250 - ETSECCPB - Barcelona School of Civil Engineering

Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering

Academic year: 2015

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Teaching unit Compulsory)

ECTS credits: 9 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: FRANCISCO JAVIER OLIVER OLIVELLA

Others: ESTER COMELLAS SANFELIU, ORIOL LLOBERAS VALLS, 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:

8226. Comprehension and mastery of the laws governing the thermomechanics of continuous media for their application in fields of engineering such as fluid mechanics, the mechanics of materials, structural theory, etc.

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.

Learning objectives of the subject

Students will acquire advanced knowledge of the laws of thermodynamics for continuous media and learn how they apply to engineering disciplines such as fluid mechanics, mechanics of materials and structural theory.

Upon completion of the course, students will be able to:

Describe motion, deformation and stress;
Apply conservation equations to structural problems in hydraulics and geotechnics;
Model the behaviour of solid and fluid materials and interpret the results.

History of the mechanics of continuous media in the context of civil engineering; Describing motion: Lagrange-Euler formulation; Deformations of a continuous medium and compatibility equations; Motion and deformations in cylindrical and spherical coordinates; Cauchy stress, postulates and equations; Mohr's circle stress analysis; Equations of conservation of mass, momentum and energy; Thermodynamics of continuous media; Fundamentals of constitutive equations; Theory of elasticity, plasticity, fracture criteria and viscoplasticity; Principle of virtual work; Fluid constitutive behaviour; Fluid mechanics; Equations of motion; Turbulence.

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Study load

Total learning time: 225h	Theory classes:	38h 58,2m	17.32%
	Practical classes:	19h 31,8m	8.68%
	Laboratory classes:	19h 31,8m	8.68%
	Guided activities:	2h 58,2m	1.32%
	Self study:	144h	64.00%

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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: 14h 23m

Theory classes: 3h 30m
Practical classes: 2h 30m
Self study : 8h 23m

Description:
Theory
Problems

Deformation and Strain

Learning time: 24h

Theory classes: 7h 30m
Practical classes: 2h 30m
Self study : 14h

Description:
Theory
Problems

Compatibility Equations

Learning time: 7h 11m

Theory classes: 2h
Laboratory classes: 1h
Self study : 4h 11m

Description:
Theory and problems

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Stress	Learning time: 21h 36m Theory classes: 7h 30m Practical classes: 1h 30m Self study : 12h 36m

Description:
Theory
Problems

Conservation and Balance Equations	Learning time: 31h 12m Theory classes: 9h Practical classes: 3h Laboratory classes: 1h Self study : 18h 12m

Description:
Theory
Problems

Linear Elasticity	Learning time: 27h 36m Theory classes: 7h 30m Practical classes: 4h Self study : 16h 06m

Description:
Theory
Problems

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

Description:
Theory

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Plasticity	Learning time: 22h 48m Theory classes: 5h Practical classes: 3h 30m Laboratory classes: 1h Self study : 13h 18m

Description:
Theory
Problems

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

Description:
Theory

Fluid Mechanics	Learning time: 19h 12m Theory classes: 5h Practical classes: 3h Self study : 11h 12m

Description:
Theory
Problems

Variational Principles	Learning time: 4h 48m Theory classes: 1h Laboratory classes: 1h Self study : 2h 48m

Description:
Theory and problems

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Qualification system

The assessment of the course will be based on four individual partial tests containing different groups of topics. One hour will be given to answer each of these tests. The tests will take place throughout the course and during class hours. The final mark of the evaluation will be obtained as a combination of the arithmetic mean (with a weight of 0.9) and the geometric mean (with a weight of 0.1) of the partial assessments over 10 points. The result will be rounded to the inferior multiple of 0.1 to obtain the final mark of the course (NF). To pass the course, one must achieve a NF greater than or equal to 5.

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.

Bibliography

Basic:

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

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

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

Complementary:

E.W.V. Chaves. Notes on Continuum Mechanics. Barcelona: Springer and CIMNE, 2013.

E.W.V. Chaves. Mecánica del Medio Continuo: Conceptos Básicos. Barcelona: CIMNE, 2009.

E.W.V. Chaves. Mecánica del Medio Continuo: Modelos Constitutivos. Barcelona: CIMNE, 2009.

Y.K. Fung. Foundations of Solids Mechanics. Prentice-Hall. 1965.

G.A. Holzapfel. Nonlinear Solid Mechanics. A Continuum Approach for Engineering. West Sussex, England (UK): John Wiley and Sons, 2008. ISBN 0471823198.

L.E. Malvern. Introduction to the Mechanics of a Continous Medium. Englewood Cliffs, NJ: Prentice-Hall, 1969.

A.J.M. Spencer. Continuum Mechanics. New York: John Wiley and Sons, 1980. ISBN 0470203994.