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250403 - ANALESTR - Structural Analysis

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)
MASTER'S DEGREE IN ENVIRONMENTAL ENGINEERING (Syllabus 2009). (Teaching unit Optional)
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Teaching unit Optional)

ECTS credits: 7,5 Teaching languages: Catalan, Spanish, English

Teaching staff

Coordinator: RAMON CODINA ROVIRA

Others: GABRIEL BUGEDA CASTELLTORT, MIGUEL ENRIQUE CERROLAZA RIVAS, RAMON CODINA ROVIRA, POOYAN DADVAND, JUAN MIQUEL CANET, BENJAMIN SUAREZ ARROYO

Opening hours

Timetable: After each class. Any time by appointment with the professor

Degree competences to which the subject contributes

Specific:

8162. Knowledge of all kinds of structures and materials and the ability to design, execute and maintain structures and buildings for civil works.

8228. Knowledge of and competence in the application of advanced structural design and calculations for structural analysis, based on knowledge and understanding of forces and their application to civil engineering structures. The ability to assess structural integrity.

8230. The ability to plan, dimension, construct and maintain hydraulic works.

Teaching methodology

The course consists of 4 hours a week of classes for 13 weeks.

Lectures are devoted to 2.5 hours in which the teacher presents the basic concepts and materials matter, presents examples and exercising.

One hour are devoted to solving problems with more interaction with students. Practical exercises with the weekend consolidate the objectives of general and specific learning.

The rest of weekly hours devoted to laboratory practice.

Support material is used in detailed teaching plan format through the virtual campus ATENEA: content, programming and evaluation activities directed learning and literature.

Learning objectives of the subject

Students will learn to analyse the resistance behaviour of structures and to use analytical and numerical methods to

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dimension mechanisms of resistance in accordance with applicable regulations.

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

Apply matrix methods of structural analysis and calculation, either developing specific software for this purpose or modifying existing software;
Apply the finite element method to perform structural analyses and calculations, using or modifying existing software;
Use the second-order method to conduct structural stability analyses.

Advanced structural calculation; Kinematic hypothesis, energy theorems, motion-force relationships; Plate resistance behaviour and its application to plane surface structures; Sheet resistance behaviour and its application to tank structures; Matrix methods for structural calculations; Calculation and programming of matrix methods; Basic concepts of the FEM: Application to bar structures; Basic aspects of the dynamic calculation of structures; Concepts of mass matrix and damping matrix; Basic aspects of structural stability and second-order analysis; Current regulations on actions, calculation and implementation.

Ability to apply knowledge of structural analysis to understand its operation and to size them resistant following existing rules and calculation methods using analytical and numerical.

Making a calculation / analysis of structures using matrix methods even developing a computer program or using / modifying an existing one.
Making a calculation / analysis of structures using the finite element method using / modifying existing computer program.
Perform calculations / structural analysis considering material nonlinearity

Knowledge of advanced calculus of structures. Kinematic hypotheses, theorems, energy, motion-relations efforts. Strong working knowledge of the plates and their application to flat surface structures. Strong working knowledge of the films and their application to structures of deposits. Knowledge of specific matrix methods for calculating structures. Knowledge of issues relating to estimating and scheduling matrix methods. Knowledge of the basics of the MEF. Application bar structures. Basic knowledge of dynamic analysis of structures. Definition of the concepts of mass and damping matrix. Knowledge of the behavior of nonlinear materials, plastic hinges and break lines.

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Study load

	Theory classes:	32h 28,8m	17.32%
	Practical classes:	16h 16,8m	8.68%
	Laboratory classes:	16h 16,8m	8.68%
	Guided activities:	2h 28,8m	1.32%
	Self study:	120h	63.99%

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Total learning time: 187h	

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31,2m	

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Content

Differential and Integral Formulation in Beam: Exact and Approximate Solutions

Learning time: 24h

Theory classes: 4h
Practical classes: 2h
Laboratory classes: 4h
Self study : 14h

Description:
Study the resistance behavior of a beam with a differential equation or an integral equation
Exercises
Laboratory

Specific objectives:
Familiar with the operation of the approximate solutions of differential equations and integral

Matrix Methods for Structural Analysis

Learning time: 36h

Theory classes: 8h
Practical classes: 5h
Laboratory classes: 2h
Self study : 21h

Description:
Stiffness Matrix, Flexibility, Balance, Transfer. Calculate the stiffness matrices and forces at the nodes of any type bars
Exercices

Specific objectives:
Solved by matrix methods bar structures of any type, straight, curved or variable inertia. Training in management and matrix operations

Resistant behavior of plates and shells

Learning time: 36h

Theory classes: 8h
Practical classes: 5h
Laboratory classes: 2h
Self study : 21h

Description:
Calculation of plates and shells. Methods of Finite Differences and Finite Element
Exercices

Specific objectives:
Assessment and interpretation of results obtained in plates and shells with informatics applications

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Dynamic and Seismic Calculus	Learning time: 28h 47m Theory classes: 6h Practical classes: 3h Laboratory classes: 3h Self study : 16h 47m

Description:
Systems with one degree of freedom, response spectra, modal decomposition, step by step integration
Exercices
Laboratory

Specific objectives:
Understand and analyze the behavior of simple structures under dynamic loads and seismic

Nonlinear behavior of the material: Beams, Frames and Plates	Learning time: 31h 12m Theory classes: 6h Practical classes: 3h Laboratory classes: 4h Self study : 18h 12m

Description:
Main characteristics of nonlinear materials. The plastic hinge. The break lines. Breakage mechanisms. Calculation Methods
Exercices
Laboratory

Specific objectives:
Understanding the scope of the strength design methods both in frames and on plates

Qualification 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.

Regulations for carrying out activities

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

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Bibliography

Basic:

R.K. Livesley. Métodos matriciales para càlculo de estructuras. Blume, 1970.

S.P Timoshenko y S. Woinowsky-Krieger. Teoria de placas y láminas. Urmo, 1975.

J.M. Canet y A. Barbat. Estructuras sometidas a acciones sismicas. CIMNE, 1988.

E. Oñate. Cálculo de Estructuras por el Método de los Elementos Finitos. CIMNE, 1992.

R. Argüelles. Cálculo de Estructuras, Vols. I,II,III. E.T.S Ingenieros de Montes, 1986.