Structural Analysis (250403)

General information

School:	ETSECCPB
Departments:	751 - Departament d'Enginyeria Civil i Ambiental
Credits:	7.5 ECTS
Programs:	872 - MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012), 1140 - MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015)
Course:	2015/2016
Course language:	Castellano

Faculty

Responsible faculty: Ramon Codina Rovira

Teachers: Gabriel Bugeda Castelltort, Ramon Codina Rovira, Pooyan Dadvand

Generic objectives

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

Skills

Specific skills

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

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.

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

Generic skills of subject

FOREIGN LANGUAGE FOR SCIENCE AND TECHNOLOGY: Knowledge of English as a global language to a sufficient oral and written level, in keeping with what is required of master's degree students. The ability to prepare a technical or scientific paper in English for international publication. (Students must achieve Level C English by the time they graduate.)

USE OF INTERNATIONAL INFORMATION RESOURCES: The ability to gather information from general and specialised international databases. The ability to find the most innovative and up-to-date information, compare it and identify its strengths and weaknesses.

ECTS credits: total hours of student work

		Dedication	
		Hours	Percent

Supervised Learning	**Theory**	32.00	47.4%
	Assignments	18.00	26.7%
	Laboratory	15.00	22.2%
	Supervised activities	2.50	3.7%
Self-Learning		120.00	

Contents

Differential and Integral Formulation in Beam: Exact and Approximate Solutions

Dedication

4.0h. Theory + 2.0h. Assignments + 4.0h. Laboratory

Description

Study the resistance behavior of a beam with a differential equation or an integral equation

Exercises

Laboratory

Objectives

Familiar with the operation of the approximate solutions of differential equations and integral

Matrix Methods for Structural Analysis

Dedication

8.0h. Theory + 5.0h. Assignments + 2.0h. Laboratory

Description

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

Exercices

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

Dedication

8.0h. Theory + 5.0h. Assignments + 2.0h. Laboratory

Description

Calculation of plates and shells. Methods of Finite Differences and Finite Element

Exercices

Objectives

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

Dynamic and Seismic Calculus

Dedication

6.0h. Theory + 3.0h. Assignments + 3.0h. Laboratory

Description

Systems with one degree of freedom, response spectra, modal decomposition, step by step integration

Exercices

Laboratory

Objectives

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

Nonlinear behavior of the material: Beams, Frames and Plates

Dedication

6.0h. Theory + 3.0h. Assignments + 4.0h. Laboratory

Description

Main characteristics of nonlinear materials. The plastic hinge. The break lines. Breakage mechanisms. Calculation Methods

Exercices

Laboratory

Objectives

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

Activities

Training in the management of a software tool for calculating matrix bar structures

Dedication

1.0 h. Supervised activities

Training in the management of a software tool for calculating plates and shells

Dedication

1.5 h. Supervised activities

Grading rules (*)

(*) The evaluation calendar and grading rules will be approved before the start of the course.

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.

Test rules

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

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.

Office hours

After each class. Any time by appointment with the professor

Basic bibliography

- 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.