Structural Analysis (250403)

General Information

School	ETSECCPB
Departments	Departament d'Enginyeria Civil i Ambiental (DECA)
Credits	7.5 ECTS
Programs	MÀSTER UNIVERSITARI EN ENGINYERIA DE CAMINS, CANALS I PORTS (pla 2012) MÀSTER UNIVERSITARI EN ENGINYERIA ESTRUCTURAL I DE LA CONSTRUCCIÓ (pla 2015) PARS: ENGINYER/A DE CAMINS, CANALS I PORTS (pla 2022)
Course	2024/25

Main teaching language at each group

- Group 10EN2 English (Q2)
- Group 10ES1 Spanish (Q1)

Faculty

Responsible Faculty: Ramon Codina Rovira
Faculty: Gabriel Bugeda Castelltort, Ramon Codina Rovira

Objectives of Education

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.

Competencies

Especific

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.

Transversal

EFFECTIVE USE OF INFORMATION RESOURCES: Managing the acquisition, structuring, analysis and display of data and information in the chosen area of specialisation and critically assessing the results obtained.
FOREIGN LANGUAGE: Achieving a level of spoken and written proficiency in a foreign language, preferably English, that meets the needs of the profession and the labour market.

Total hours of student work

		Hours	Percentage
Supervised Learning	Large group	34.95 h	51.77 %
	Medium group	16.28 h	24.11 %
	Laboratory classes	16.28 h	24.11 %
	Guided Activities	0.0 h	0.00 %
Self Study		120.0 h	

Contents

Differential and Integral Formulation in Beam: Exact and Approximate Solutions

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

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

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

Dynamic and Seismic Calculus

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

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

Activities

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

Dedication

1h

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

Dedication

1h 30m

Teaching Methodology

The course consists of 5 hours a week of classes for 13 weeks.

Lectures are devoted to 3 hours in which the teacher presents the basic concepts and materials matter, presents examples and exercising.

1,5 hours 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.

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.

Grading Rules

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

The final grade of the subject is obtained from the grades of the exams (90%) and the assignments (10%).

There will be 3 exams, the first corresponding to subjects 1 and 2 (40%), the second to subject 3 (20%) and the third to subjects 4 and 5 (40%).

There will be 4 course assignments. All of them will weigh 25% of the assignment grade.

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.

Office Hours

After each class. Any time by appointment with the professor

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.
- Oñate Ibañez de Navarra, E. Cálculo de estructuras por el método de los elementos finitos. Artes Gráficas Torres. Barcelona: CIMNE, 1992. ISBN 8487867006.
- R. Argüelles. Cálculo de Estructuras, Vols. I,II,III. E.T.S Ingenieros de Montes, 1986.