

Course guide

250403 - ANALESTR - Structural Analysis

Last modified: 21/06/2024

Unit in charge: Barcelona School of Civil Engineering
Teaching unit: 751 - DECA - Department of Civil and Environmental Engineering.

Degree: MASTER'S DEGREE IN CIVIL ENGINEERING (PROFESSIONAL TRACK) (Syllabus 2012). (Compulsory subject).
MASTER'S DEGREE IN STRUCTURAL AND CONSTRUCTION ENGINEERING (Syllabus 2015). (Optional subject).

Academic year: 2024 **ECTS Credits:** 7.5 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: RAMON CODINA ROVIRA

Others: GABRIEL BUGEDA CASTELLTORT, RAMON CODINA ROVIRA

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.

Transversal:

8562. 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.

8563. 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.

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.

LEARNING OBJECTIVES OF THE SUBJECT

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.

STUDY LOAD

Type	Hours	Percentage
Hours medium group	16,3	8.69
Hours large group	35,0	18.66
Self study	120,0	63.97
Hours small group	16,3	8.69

Total learning time: 187.6 h

CONTENTS

Differential and Integral Formulation in Beam: Exact and Approximate Solutions

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

Full-or-part-time: 24h

Theory classes: 4h

Practical classes: 2h

Laboratory classes: 4h

Self study : 14h

Matrix Methods for Structural Analysis

Description:

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

Exercises

Specific objectives:

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

Full-or-part-time: 36h

Theory classes: 8h

Practical classes: 5h

Laboratory classes: 2h

Self study : 21h

Resistant behavior of plates and shells

Description:

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

Exercises

Specific objectives:

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

Full-or-part-time: 36h

Theory classes: 8h

Practical classes: 5h

Laboratory classes: 2h

Self study : 21h

Dynamic and Seismic Calculus

Description:

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

Exercises

Laboratory

Specific objectives:

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

Full-or-part-time: 28h 47m

Theory classes: 6h

Practical classes: 3h

Laboratory classes: 3h

Self study : 16h 47m

Nonlinear behavior of the material: Beams, Frames and Plates

Description:

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

Exercises

Laboratory

Specific objectives:

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

Full-or-part-time: 31h 12m

Theory classes: 6h

Practical classes: 3h

Laboratory classes: 4h

Self study : 18h 12m

GRADING SYSTEM

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.

EXAMINATION RULES.

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

BIBLIOGRAPHY

Basic:

- R.K. Livesley. Métodos matriciales para cálculo 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 sísmicas. 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.
- Argüelles, R. Cálculo de Estructuras, Vols. I,II,III. Madrid: E.T.S Ingenieros de Montes, 1986. ISBN 8460024105.