Course guide
2500037 - GECCALCEST - Structural Design

Last modified: 01/10/2023

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

Degree: BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2020). (Optional subject).

Academic year: 2023 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: LUIS MIGUEL CERVERA RUIZ

Others: JOAN BAIGES AZNAR, LUIS MIGUEL CERVERA RUIZ, JOSE MANUEL GONZALEZ LOPEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14410. Knowledge of the typology and calculation bases of prefabricated elements and their application in manufacturing processes. (Specific technology module: Civil Construction)
14411. Knowledge about the project, calculation, construction and maintenance of building works in terms of structure, finishes, facilities and own equipment. (Specific technology module: Civil Construction)

Generical:
14380. Scientific-technical training for the exercise of the profession of Technical Engineer of Public Works and knowledge of the functions of advice, analysis, design, calculation, project, construction, maintenance, conservation and exploitation.
14383. Ability to project, inspect and direct works, in their field.
14390. Identify, formulate and solve engineering problems. Pose and solve construction engineering problems with initiative, decision-making skills and creativity. Develop a systematic and creative method of analysis and problem solving. (Additional school competition).
14391. Conceive, project, manage and maintain systems in the field of construction engineering. Cover the entire life cycle of an infrastructure or system or service in the field of construction engineering. (Additional school competition).

TEACHING METHODOLOGY

The course consists of 4 hours per week of classes during the 15 weeks of the semester.
The approximate distribution of the 60 contact hours is as follows:
36 hours of lectures devoted to the exposition of the concepts and materials of the course.
12 hours of practical sessions devoted to the presentation of examples and exercises and problems.
4 hours laboratory and directed activities devoted to practical exercises to consolidate the objectives of general and specific learning of the subject.
8 hours devoted to assessment.

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

Knowledge of structural reliability and the bases of the structural project. Funicular structures. Second order analysis. Plastic calculus. Plates. Shells. Dynamic analysis.

1 Capacity for the project, calculation, construction and maintenance of building works in terms of structure and foundation structures, finishes, facilities and own equipment.
2 Ability to identify different types of prefabricated elements and their calculation bases and capacity for their application in manufacturing processes.

Calculation basis for the project of structures. Knowledge of the existing regulations for actions, calculation and execution. Knowledge of the project bases for the design and/or verification of structures. Ultimate limit states and service limit states. Plate analysis. Approximate methods of plate analysis. Rupture methods. Introduction to elasticity. Discretization of continuous systems: the finite element method. 2D and 3D elasticity problems. Preprocessing and postprocessing. Introduction to dynamic and seismic analysis. Systems of one degree of freedom. Response spectra. Systems with many degrees of freedom. Nonlinear calculation of structures. Nonlinear Material: Plastic Moment Theory; Moment/curvature diagrams. Geometric nonlinearity: Instability.

STUDY LOAD

Type	Hours	Percentage
Self study	84,0	56.00
Hours medium group	30,0	20.00
Hours large group	30,0	20.00
Guided activities	6,0	4.00

Total learning time: 150 h

CONTENTS

Structural reliability and structural basis of design

Description:
Introduction. Semiprobabilista probabilistic representation and representation. Required reliability. Actions, action effects (surround, lines of influence) and combination of actions. Limit states.
Structural reliability and structural design bases. Problems
Structural reliability and structural design bases. Laboratory

Full-or-part-time: 28h 47m
Theory classes: 6h
Practical classes: 2h
Laboratory classes: 4h
Self study : 16h 47m

Funicular Structures

Description:
Cables. Arcos.
Funicular Structures. Problems

Full-or-part-time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Second-order analysis

Description:
Slender columns. Isolated concrete column. Isolated concrete column and steel
Analysis of second order. Problems

Full-or-part-time: 9h 36m
Theory classes: 2h
Practical classes: 2h
Self study : 5h 36m

Plastic Analysis

Description:
Introduction to plastic design. Calculation plastic sections. Elastoplastic behavior of a beam isostatic. General Survey of statically indeterminate systems. Resolution of beams and frames by Theorem maximum and minimum theorem combination of mechanisms.
Plastic calculation. Problems

Full-or-part-time: 19h 12m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 11h 12m

Plates

Description:
Differential Equation of Equilibrium of a plate with the Kirchhoff-Love hypothesis. Boundary Conditions. Navier solution for different types of loads. Evaluation of flat grates. Method of virtual frames by EHE and analysis of plates on point supports.
Plates. Problems

Full-or-part-time: 24h
Theory classes: 6h
Practical classes: 4h
Self study : 14h

Shells

Description:
Introduction. General Equations of behavior. Cylindrical shells.
Sheets. Problems

Full-or-part-time: 19h 12m
Theory classes: 4h
Practical classes: 2h
Laboratory classes: 2h
Self study : 11h 12m

Dynamic Analysis

Description:
Introduction. Rigidity. Damping and excitation dynamics. Undamped free vibration-free damped, forced harmonic and transient integral convolution. Seismicity and accelerograms. Equations of dynamic equilibrium of systems of various degrees of freedom. Introduction to matrix analysis.
Dynamic Analysis. Problems
Dynamic Analysis. Laboratory

Full-or-part-time: 33h 36m
Theory classes: 8h
Practical classes: 2h
Laboratory classes: 4h
Self study : 19h 36m

GRADING SYSTEM

The final grade is the weighted average of the one obtained in the periodic evaluation exercises (AV), the exercises carried out in the practical classes and directed activities (AD) and in the final work of the subject (AT).

The periodic evaluation (A) is obtained as: AV = 0.4 * A1 + 0.6 * A2, being A1 and A2 the two periodic evaluations.

The final grade for the subject will be:

Subject grade = 0.3*(AV grade) + 0.3*(AD grade) + 0.6*(AT grade)

if each of the AV, AD and AT grades has obtained a grade equal to or greater than 5.0. Otherwise, the mark of the subject will be:

Subject grade = 0.3*(Nota AV) + 0.1*(Nota AD) + 0.6*(Nota AT)

To pass , the mark of the course must be equal to or greater than 5.0.

Criteria for qualification and admission to re-evaluation: Students suspended in the ordinary evaluation who have regularly taken the evaluation tests of the failed subject will have the option to take a re-evaluation test in the period established in the academic calendar. The students who have already passed it or the students qualified as not presented will not be able to present themselves to the re-evaluation test of a subject. The maximum grade in the case of taking the reevaluation exam will be five (5.0). The non-attendance of a student summoned to the re-evaluation test, held within the established period, may not give rise to another test with a later date Extraordinary evaluations will be carried out for those students who, due to proven force majeure, have not been able to carry out any of continuous assessment tests. These tests must be authorized by the corresponding head of studies, at the request of the professor responsible for the subject, and will be carried out within the corresponding academic period.

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:
- Cervera, M.; González, J.M. Mecánica avanzada de estructuras [on line]. Barcelona: CIMNE, 2020 [Consultation: 23/03/2021]. Available on: https://www.researchgate.net/publication/344076329_Mecanica_Avanzada_de_Estructuras. ISBN 9788412110135.
- Cervera, M.; Blanco, E. Mecánica de estructuras [on line]. 2a ed. Barcelona: Edicions UPC, 2002 [Consultation: 04/05/2021]. Available on: http://hdl.handle.net/2099.3/36196. ISBN 8483016354.
- Cervera, M.; Blanco, E. Resistencia de materiales [on line]. Barcelona: CIMNE, 2015 [Consultation: 23/03/2021]. Available on: https://www.researchgate.net/publication/309763299_Resistencia_de_Materiales. ISBN 9788494424441.
- Cervera, M.; Blanco, E. Mecánica y resistencia de materiales. Barcelona: CIMNE, 2012. ISBN 9788494024399.

Complementary:
- Torroja, E. Razón y ser de los tipos estructurales. Madrid: Colegio de Ingenieros de Caminos, Canales y Puertos, 2007. ISBN 9788438003701.
- Muttoni, A. L'art d'estructures . Une introduction au fonctionnement des structures en architecture. 2e ed. Lausanne, Switzerland: Presses Polytechnique et Universitaires Romandes, 2012. ISBN 9782880749804.
- Argüelles, R. Cálculo de estructuras: tomo II. Madrid: Escuela Técnica Superior de Ingenieros de Montes, 1986. ISBN 8460024121.
- Argüelles, R ... [et al.]. Cálculo matricial de estructuras en primer y segundo orden: teoría y problemas. Madrid: Bellisco, 2005. ISBN 8496486125.
- Barbat, A; Canet, J.M. Estructuras sometidas a acciones sísmicas : cálculo por ordenador. 2a ed. Barcelona: CIMNE, 1994. ISBN 8487867103.