Course guide
2500021 - GECESTRUCT - Structures

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). (Compulsory subject).

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

LECTURER

Coordinating lecturer: LUIS MIGUEL CERVERA RUIZ, RICCARDO ROSSI BERNECOLI

Others: LUIS MIGUEL CERVERA RUIZ, ALEJANDRO CORNEJO VELÁZQUEZ, IVÁN RIVET FERNÁNDEZ, RICCARDO ROSSI BERNECOLI, RUBÉN ZORRILLA MARTÍNEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14401. Ability to analyze and understand how the characteristics of structures influence their behavior. Ability to apply knowledge about the resistant operation of structures to size them according to existing regulations and using analytical and numerical calculation methods. (Common module to the Civil branch)

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.
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).

TEACHING METHODOLOGY

The course consists of 4 hours a week of classes during the 15 weeks of the semester.
The approximate distribution of the 60 contact hours is:
15 hours of lectures devoted to the exposition of the concepts and basic materials for the course.
15 hours of practical sessions devoted to the presentation of examples and exercises and problems.
24 hours laboratory and directed activities devoted to practical exercises to consolidate the objectives of general and specific learning of the subject.
6 hours devoted to psychological testing.

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 on fundamentals of structural analysis. Forces and movements. Work and energy. Compatibility method. Equilibrium method. Rigidity method.

1 Ability to understand and apply the fundamentals of structural analysis and to understand energy theorems and their utility.
2 Ability to apply equilibrium and compatibility methods to structural analysis.
3 Ability to perform analysis and calculation of structures through the using computer software.

Ability to apply knowledge on the strength of structures to design them following existing regulations and using analytical and numerical calculation methods. Ability to obtain the forces laws of structures and the deformed shape by different calculation methods. Fundamentals of structural analysis. Knowledge of the resolution methods of common typologies (continuous beams, frames, arches). Continuous structures and bar structures. Articulated and reticulated structures. Forces and movements. Knowledge of energy theorems (virtual works, Castigliano, minimal work, Maxwell). Work and energy in structural systems. Total potential energy. Supports and elastic links. Compatibility and equilibrium methods. Continuous beams. Frames. Imposed movements and deformations. Stiffness method. Calculation of movements, forces and reactions. Releases. Typologies of frame structures. Knowledge of structures calculation using computer software.

STUDY LOAD

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

Total learning time: 150 h

CONTENTS

Fundamentals of Structural Analysis

Description:
Continuous structures and bar structures. Articulated and crosslinked structures. Equilibrium and compatibility. Static indeterminacy. Indeterminate degree. Indetermiación kinematics. Translational degree. Equilibrium and compatibility in symmetrical structures. Movements and deformations taxes. Isostatic and hyperstatic structures, methods of analysis. Articulated structures.

Fundamentals of Structural Analysis. Problems
Fundamentals of Structural Analysis. Laboratory

Full-or-part-time: 33h 36m
Theory classes: 2h
Practical classes: 2h
Laboratory classes: 10h
Self study : 19h 36m

Stresses and Movements

Description:
Differential equation of the deflection of a beam line. Navier formulas for planar structures. Elastic equations.
Efforts and movements. Problems
Efforts and movements. Laboratory

Full-or-part-time: 14h 23m
Theory classes: 2h
Practical classes: 2h
Laboratory classes: 2h
Self study : 8h 23m

Work and Energy

Description:
Work and energy. Work and energy in structural systems. Work and complementary work. Reciprocity theorems. Strain energy and complementary energy. Virtual work. Total potential energy. Theorems of Castigliano. Elastic supports and links.

Work and Energy. Problems
Work and Energy

Full-or-part-time: 33h 36m
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 6h
Self study : 19h 36m

Compatibility Method

Description:
Bases of the method. Continuous beams: equation of three moments, support settlements, elastic supports. Frames. Imposed movements and deformations.

Compatibility method. Problems
Compatibility method. Laboratory

Full-or-part-time: 9h 36m
Theory classes: 1h
Practical classes: 1h
Laboratory classes: 2h
Self study : 5h 36m

Equilibrium Method

Description:
Bases of the method. Continuous beams: equation of the three rotations, support settlements, elastic supports. Frames: intraslational and traslational frames
Balance Method. Problems
Balance Method. Laboratory

Full-or-part-time: 33h 36m
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 6h
Self study : 19h 36m

Stiffness method

Description:
Bases of the method. Geometric definition of the structure. Elemental stiffness matrix. Global stiffness matrix. Prescribed displacements. Computation of displacements, resultants and reactions. Loads acting on the bars. Types of bar structures.

Stiffness method. Problems
Stiffness method. Laboratory

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

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 = 0.4*(AV grade) + 0.4*(AD grade) + 0.4*(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 = 0.7*(Nota AV) + 0.1*(Nota AD) + 0.2*(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.

If you do not perform any activities of continuous assessment or final work subject in the scheduled period, is considered zero punctuation.

BIBLIOGRAPHY

Basic:
- 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. Mecánica y resistencia de materiales. Barcelona: CIMNE, 2012. ISBN 9788494024399.
- Cervera, M.; Blanco, E. Resistencia de materiales [on line]. Barcelona: CIMNE, 2015 [Consultation: 11/05/2022]. Available on: https://www.researchgate.net/publication/309763299_Resistencia_de_Materiales. ISBN 9788494424441.

Complementary:
- West, H.H. Fundamentals of structural analysis. 2nd ed. New York: Wiley, 2002. ISBN 0471355569.
- Juan Miquel Canet. Cálculo de estructuras. Libro2: Sistemas de piezas prismáticas [on line]. Edicions UPC, 2000 [Consultation: 29/04/2020]. Available on: http://hdl.handle.net/2099.3/36158. ISBN 8483013983.
- Hibbeler, R.C. Structural analysis. 9th ed. Upper Saddle River [etc.]: Prentice Hall, 2015. ISBN 9780133942842.
- Leet, K.M.; Uang, C.M.; Gilbert, A.M. Fundamentals of structural analysis. 4th ed. New York: McGraw Hill, 2011. ISBN 9780071289382.
- Hibbeler, R.C. Análisis estructural [on line]. 8a ed. Naucalpán de Juárez, México: Pearson, 2012 [Consultation: 07/12/2020]. Available on: https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=1517. ISBN 9786073210621.