Course guide
2500016 - GECRESIMAT - Strength of Materials

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, PAVEL RYZHAKOV

Others: LUIS MIGUEL CERVERA RUIZ, UXUE CHASCO GOÑI, JOSE MANUEL GONZALEZ LOPEZ, RICCARDO ROSSI BERNECOLI, PAVEL RYZHAKOV, RUBÉN ZORRILLA MARTÍNEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
14394. Basic knowledge about the use and programming of computers, operating systems, databases and computer programs with engineering application. (Basic training module)
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.
14389. Knowledge of the history of civil engineering and training to analyze and assess public works in particular and construction in general.

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 the evaluation tests.

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 mechanics of solids and theory of elasticity. Fundamentals of the strength of materials. Axial Force. Bending Moment. Shear force. Torsor Moment

1 Ability to apply the basic concepts of solid mechanics and elasticity theory to basic structural problems.
2 Ability to obtain the force laws of structures and deformation by analytical methods of calculation.
3 Ability to obtain stress distributions that generate the forces acting in sections of different types.

Ability to analyze and understand how the characteristics of structures influence their behavior. Basic knowledge to solve problems about performance of structures to design them. Knowledge of the basic fundamentals of strength of materials and structures. Introduction to solid mechanics. Introduction to elasticity theory. Determination of stresses and displacements derived from external forces. Stress and deformation laws in isostatic structures. Knowledge of the sectional behavior and of the stresses obtained from the acting forces in a section (axial, bending, shear and torsion).

STUDY LOAD

Type	Hours	Percentage
Guided activities	6,0	4.00
Hours small group	6,0	4.00
Hours large group	30,0	20.00
Self study	84,0	56.00
Hours medium group	24,0	16.00

Total learning time: 150 h

CONTENTS

Solid mechanics and elasticity theory

Description:
Stress. Stress tensor. Movement and deformation. Strain tensor. Linear elasticity. Hooke's law. Stress-strain relationship. Experimental study. Limit stress, allowable stress and safety factor. Equivalent stress and strength criteria.

Solid mechanics and elasticity theory. Problems
Solid mechanics and elasticity theory. Laboratory

Full-or-part-time: 38h 24m
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 8h
Self study : 22h 24m

Fundamentals of Strength of Materials

Description:
Beam and structure concepts. Principles of Strength of Materials. Definition of stress resultants in one section. Relationship between stress and strain. Resultants in mid-plane beams. Equilibrium equations in straight beams. Support structures and links in the middle plane. Isostatic and hyperstatic structures. Stress resultants diagrams. Analysis of hyperstatic structures.
Fundamentals of Strength of Materials. Problems
Foundations of Strength of Materials. Laboratory

Full-or-part-time: 14h 23m
Theory classes: 1h
Practical classes: 1h
Laboratory classes: 4h
Self study : 8h 23m

Axial force

Description:
Axial force in straight beams. Sections of several materials. articulated structures: Isostatic and hyperstatic.
Axial force. Problems
Axial force. Laboratory

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

Bending moment

Description:
Pure bending. Skew pure bending. Bending in beams of small curvature. Sections of various materials. Composite bending.
Bending moment. Problems
Bending moment. Laboratory

Full-or-part-time: 48h
Theory classes: 6h
Practical classes: 6h
Laboratory classes: 8h
Self study : 28h

Shear

Description:
Elementary theory of sheart. Collignon's Formula.
Solid sections. Thin sections. Warping deformation. Shear center. Sections of various materials.

Shear. problems
Shear. Laboratory

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

Torque

Description:
Coulomb torsion. Saint-Venant torsion. Analogy of the membrane. Rectangular sections. Open thin sections. Hydrodynamic analogy. Closed thin sections.

Torque. Problems
Torque. Laboratory

Full-or-part-time: 14h 23m
Theory classes: 1h
Practical classes: 1h
Laboratory classes: 4h
Self study : 8h 23m

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 = 0.7*(AV grade) + 0.4*(AD grade) + 0.1*(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 = 0.8*(Nota AV) + 0.1*(Nota AD) + 0.1*(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 perform any of the ongoing evaluation activities and laboratory in the scheduled period will be considered as zero score.

BIBLIOGRAPHY

Basic:
- 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.
- Cervera, M.; Blanco, E. Mecánica y resistencia de materiales. Barcelona: CIMNE, 2012. ISBN 9788494024399.

Complementary:
- Ortiz, L. Resistencia de materiales [on line]. 3a ed. Madrid: McGraw Hill, 2007 [Consultation: 24/11/2020]. Available on: https://www.ingebook.com/ib/NPcd/IB_BooksVis?cod_primaria=1000187&codigo_libro=3962. ISBN 9788448156336.

- Bickford, W.B. Mecánica de sólidos : conceptos y aplicaciones. Baltimore ; Barcelona: Irwin, 1995. ISBN 8480861703.
- Silva, V.D. da. Mechanics and strength of materials [on line]. Berlín [et al.]: Springer, 2006 [Consultation: 11/05/2021]. Available on: https://ebookcentral.proquest.com/lib/upcatalunya-ebooks/detail.action?docID=3062564. ISBN 9783540308133.
- Miquel Canet, J. Cálculo de estructuras. vol. 1: Fundamentos y estudio de secciones [on line]. Barcelona: Ediciones UPC, 2000 [Consultation: 29/04/2020]. Available on: http://hdl.handle.net/2099.3/36158. ISBN 8483013983.