Course guide
250222 - RESISMAT - Strength of Materials

Last modified: 21/11/2022

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

Degree: BACHELOR'S DEGREE IN PUBLIC WORKS ENGINEERING (Syllabus 2010). (Compulsory subject).

Academic year: 2022 **ECTS Credits:** 6.0 **Languages:** Spanish

LECTURER

Coordinating lecturer: LUIS MIGUEL CERVERA RUIZ

Others: LUIS MIGUEL CERVERA RUIZ, UXUE CHASCO GOÑI, JOSE MANUEL GONZALEZ LOPEZ, RUBÉN ZORRILLA MARTÍNEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3073. Ability to analyse and understand how the characteristics of structures influence their behaviour. Ability to apply knowledge of the resistance dynamics of structures in order to dimension them in accordance with existing regulations using analytical and numerical calculation methods

Transversal:
592. EFFICIENT ORAL AND WRITTEN COMMUNICATION - Level 2. Using strategies for preparing and giving oral presentations. Writing texts and documents whose content is coherent, well structured and free of spelling and grammatical errors.
596. TEAMWORK - Level 1. Working in a team and making positive contributions once the aims and group and individual responsibilities have been defined. Reaching joint decisions on the strategy to be followed.
599. EFFECTIVE USE OF INFORMATI0N RESOURCES - Level 3. Planning and using the information necessary for an academic assignment (a final thesis, for example) based on a critical appraisal of the information resources used.
602. SELF-DIRECTED LEARNING - Level 3. Applying the knowledge gained in completing a task according to its relevance and importance. Deciding how to carry out a task, the amount of time to be devoted to it and the most suitable information sources.
584. THIRD LANGUAGE. Learning a third language, preferably English, to a degree of oral and written fluency that fits in with the future needs of the graduates of each course.

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

Students will learn to analyse how the characteristics of structures influence structural behaviour. They will also develop the skills to solve structural behaviour problems in the structural design process.

Upon completion of the course, students will have acquired the ability to: 1. Apply basic concepts of solid mechanics and theory of elasticity to basic structural problems. 2. Find laws of stress and deformation in structures by means of analytical calculation methods. 3. Find the stress distributions that generate the forces in sections of different types.

Basic concepts of strength of materials and structural engineering; Introduction to solid mechanics; Introduction to the theory of elasticity; Calculation of stresses and displacements derived from external forces; Laws of stress and deformation in isostatic structures; Sectional behaviour and stresses derived from the forces acting on a section (axial force, bending moment, shear force and torsion)

STUDY LOAD

Type	Hours	Percentage
Guided activities	6,0	4.00
Hours medium group	15,0	10.00
Self study	84,0	56.00
Hours large group	15,0	10.00
Hours small group	30,0	20.00

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 4.0. Otherwise, the mark of the subject will be:

Mark of the subject = 1.2/ [(0.7x/Note AV) + (0.4/Note AD) + (0.1/Note 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. Mecánica y resistencia de materiales. Barcelona: CIMNE, 2012. ISBN 9788494024399.

Complementary:
- Vázquez, M. Resistencia de materiales. Madrid: Noela, 1999. ISBN 8488012055.
- 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.