Course guide
250120 - RESIMATEST - Strength of Materials and Structures

Last modified: 27/10/2022

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 2010). (Compulsory subject).
BACHELOR'S DEGREE IN CIVIL ENGINEERING (Syllabus 2017). (Compulsory subject).

Academic year: 2022 **ECTS Credits:** 9.0 **Languages:** Spanish, English

LECTURER

Coordinating lecturer: RICCARDO ROSSI BERNECOLI

Others: RICCARDO ROSSI BERNECOLI, RUBÉN ZORRILLA MARTÍNEZ

DEGREE COMPETENCES TO WHICH THE SUBJECT CONTRIBUTES

Specific:
3026. 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.
3027. Ability to calculate structures with interactive resistant mechanisms based on analytical and computational models approved by European Union regulations.
3038. Knowledge of the design, calculation, construction and maintenance of building works in regard to their structure, finishes, installations and equipment.

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 6 hours per week of classes during a semester. Of these, about half belong to classes of theoretical developments, while the other half is in the resolution of practical exercises in applying the theory previously exposed. With a proposed weekly series of exercises that students must meet outside of class time and submit for assessment. ATENEA used as a communication tool with students notes, proposed exercises, training material, etc.

Although most of the sessions will be given in the language indicated, sessions supported by other invited experts may be held in other languages. The language may change due to force majeure.

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. Find laws of stress and deformation in isostatic structures by means of analytical calculation methods. 2. Find laws of stress and deformation in hyperstatic structures by means of analytical calculation methods. 3. Find the stress distributions that generate the forces in a structure.

Fundamentals of strength of materials and structures (deformable solids, stress, motion and boundary conditions, deformation and Hooke's law); Elastic behaviour; Determination of stress and displacement due to external forces; Laws of stress and deformation; Sectional behaviour and stresses derived from the forces acting on a section (axial, bending, shear and torsional); Energy theorems (virtual work, Castigliano, least work, Maxwell, etc.); Methods for solving standard forms (continuous beams, portal frames, arches)

STUDY LOAD

Type	Hours	Percentage
Hours large group	45,0	20.00
Hours small group	15,0	6.67
Guided activities	9,0	4.00
Self study	126,0	56.00
Hours medium group	30,0	13.33

Total learning time: 225 h

CONTENTS

Introduction

Description:
Objective of the course. Scope. Brief description of the concept of stress. Concept of deformation. Elasticity. Linearity. Hooke's law. Superposition principle

Full-or-part-time: 7h 11m
Theory classes: 3h
Self study : 4h 11m

Efforts Laws

Description:
Definition of elastic piece. Reactions and linkages. Efforts in one section. Midplane parts: internal balance equations. Laws of effort. isostatic and indeterminate. Saint-Venant principle
Problems

Full-or-part-time: 31h 12m
Practical classes: 11h
Laboratory classes: 2h
Self study : 18h 12m

Axial force

Description:
Navier hypothesis. Stresses and strains. Movements. Mechanical deformations. Sections of different materials. Strain Energy
Problems

Full-or-part-time: 7h 11m
Theory classes: 2h
Practical classes: 1h
Self study : 4h 11m

Bending moment

Description:
Navier hypothesis. Parts midplane. Skew bending. Sections of various materials. Imposed deformations. Strain energy. Flex composite. Core
Problems

Full-or-part-time: 19h 12m
Theory classes: 3h
Practical classes: 5h
Self study : 11h 12m

Shear

Description:
Origin of shear stress: stress gradient. Tangential stress distribution: solid sections. Distribution of shear stresses in parts of mid-plane, thin-walled sections. Distribution of shear stresses tangential skew: thin wall sections. Shear center. Strain energy. Guests Section
Activities aimed

Full-or-part-time: 26h 24m
Theory classes: 4h
Practical classes: 4h
Laboratory classes: 3h
Self study : 15h 24m

Strain energy

Description:
Theorem of virtual work. Theorem complementary virtual work. Unit force method. Expression of the elastic energy. Theorems of Castigliano. Reciprocity theorem. Generalized stress and strain.
Problems

Full-or-part-time: 16h 48m
Theory classes: 3h
Practical classes: 3h
Laboratory classes: 1h
Self study : 9h 48m

Articulated structures

Description:
Isostatic Structures: Calculation of effort. Isostatic structures: determination of movement. Indeterminate structure: compatibility method

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Simple beams

Description:
Hipétesis Navier-Bernoulli vs. hipétesis Timoshenko. Equations of elasticity. Deflection of beams: Mohr and Castigliano's theorems. Hyperstatic beams. Elastic equations
Problems

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

Continuous beams

Description:
Method of support: (i) Calculation of vertical reactions. Method of support: (ii) Theorem of the three moments
Movements of support. Stiffness method

Full-or-part-time: 4h 48m
Theory classes: 2h
Self study : 2h 48m

Porticoes and arches

Description:
Symmetries and antimetrías. Formulas Navier-Bresse. General methodology of calculation of statically indeterminate structures by the method of support. Arches and cables. Movements and deformations imposed. Translational and intraslacionalidad. Elastic equations: (i) Equations intraslacionales elastic structures. (Ii) Equations translational elastic structures.
Problems

Full-or-part-time: 79h 12m
Theory classes: 14h
Practical classes: 15h
Laboratory classes: 4h
Self study : 46h 12m

GRADING SYSTEM

De forma continuada y en las fechas que se indica en la tabla se propondrán ejercicios. La entrega de los ejercicios es voluntaria. Dichos ejercicios deberán entregarse necesariamente a través de la Plataforma Atenea en los plazos indicados

Bajo las condiciones y en las fechas que indique la Escuela, a final de curso habrá un examen de re-evaluación. Los alumnos con nota final entre 4 y 5 que se presenten al examen de reevaluación no verán en ningún caso disminuída su nota, sea cual sea la nota obtenida en el examen de reevaluación

EXAMINATION RULES.

Attendance at all the various assessments is compulsory

BIBLIOGRAPHY

Basic:
- Miquel Canet, J. Calculo de Estructuras. Vol. 1. Fundamentos y estudio de secciones [on line]. Barcelona: Edicions UPC, 2000 [Consultation: 29/04/2020]. Available on: http://hdl.handle.net/2099.3/36158. ISBN 9788483013991.
- Miquel Canet, J. Calculo de Estructuras. Vol. 2. Sistemas de piezas prismáticas [on line]. Barcelona: Edicions UPC, 2000 [Consultation: 29/04/2020]. Available on: http://hdl.handle.net/2099.3/36158. ISBN 9788483014004.
- Gere, J.M. Resistencia de materiales (Timoshenko). 5a ed. España: International Thomson Editores, 2002. ISBN 84-9732-065-4.

Complementary:
- Popov, E.P. Engineering Mechanics of Solids. 2a ed. Upper Saddle River, N. J.: Prentice Hall, 1999. ISBN 0137261594.
- Hibbeler, R.C. Structural analysis. 9th ed. Upper Saddle River [etc.]: Prentice Hall, 2015. ISBN 9780133942842.
- West, H.H. Fundamentals of structural analysis. 2nd ed. New York: Wiley, 2002. ISBN 0471355569.
- Cervera Ruiz, M.; Blanco Díaz, E. Mecánica de estructuras. 3a ed. Barcelona: CIMNE, 2014. ISBN 9788494284489.