SUBJECT TEACHING GUIDE

G1463 - Strength of Materials

Degree in Civil Engineering
BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM

Academic year 2023-2024

1. IDENTIFYING DATA				
Degree	Degree in Civil Engineering BILINGUAL UC-CU CIVIL ENGINEERING PROGRAM		Type and Year	Compulsory. Year 2 Compulsory. Year 1
Faculty	School of civil Engineering			
Discipline	ANALYSIS AND TECHNOLOGY OF STRUCTURES Obligatory Subjects			
Course unit title and code	G1463 - Strength of Materials			
Number of ECTS credits allocated	6	Term	Semester based (1)	
Web				
Language of instruction	English		Mode of delivery	Face-to-face

Department	DPTO. INGENIERIA ESTRUCTURAL Y MECANICA
Name of lecturer	ALBERTO FERNANDEZ LEROY
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Other lecturers	RAFAEL DIEZ ALMAGRO

3.1 LEARNING OUTCOMES

- 1. Comprehension of the fundamentals of Strength of Materials: Stress, stress-resultant, strain, displacement. Strain energy.
  2. Capability for the analysis of one-dimensional structural elements subjected to axial forces (tensile and compressive), flexural actions (bending and shear effects) and torsional behaviour.
  3. Capability for the analysis of a few elementary structural systems, either statically determinate or indeterminate.

4. OBJECTIVES

1. Introduction to the fundamentals of Strength of Materials: Deformable solid bodies, elastic behaviour, linear normal stress and strain, shear stress and shear strain, stress-resultants and deformations.
2. Definition of basic stress-resultants on structural sections: Axial and shear forces, bending moments and twist moments. Stress-resultants diagrams. Stress analysis.
3. Analysis of strains and deformations on basic 1-D structural elements: Bars subjected to axial forces, bendig of beams and torsión of bars with a circular or hollow section. Introduction to the study of statically indeterminate elements. Introduction to the energy methods of structural analysis.
4. Study of stress states under combined actions. Introduction to the structural behaviour of more advanced elements: Composite sections, curved elements and arcs, cantilevers and balcony beams, elementary non-translational plane frames.

6. COURSE ORGANIZATION	
	CONTENTS
1	TENSILE, COMPRESSIVE AND SHEAR STRESSES 1.1. Normal stress and normal (linear) strain. 1.2. Mechanical properties of materials. 1.3. Linear elasticity, Hooke´s law and Poisson´s coefficient. 1.4. Shear stress and shear (angular) strain.
2	MEMBERS AXIALLY LOADED 2.1. Elongations in members axially loaded. 2.2. Elongations in non-uniform bars. 2.3. Statically indeterminate elements. 2.4. Thermal effects, manufacturing and constructions deformations.
3	TORSION 3.1. Torsional deformations of bars with circular section. 3.2. Non-uniform torsion. 3.3. Stresses and strains under pure shear actions. 3.4. Relantionship between elastic modulus (E) and shear modulus (G). 3.5. Statically indeterminate torsion. 3.6. Torsional behaviour of bars with thin-hollow section.
4	BENDING MOMENT AND SHEAR FORCE 4.1. Types of beams, loads and reactions. 4.2. Bending moments and shear forces. 4.3. Relationships between loads, bending moments and shear forces. 4.4. Bending-moment and shear-force diagrams.
5	STRESSES ON BEAMS. BASIC CONCEPTS 5.1. Uniform and non-uniform bending. 5.2. Concept of curvature of a beam. 5.3. Longitudinal deformations on beams. 5.4. Normal stresses. 5.5. Design of beams under flexural actions. 5.6. Non-prismatic beams. 5.7. Shear stresses on beams with rectangular section. 5.8. Shear stresses on beams with double T or symmetric hollow sections.
6	STRESSES ON BEAMS: ADVANCED CONCEPTS 6.1. Composite beams and stress flow. 6.2. Analysis of composite beams: Transformed section method. 6.3. Sections with double symmetry under inclined loads. 6.4. Non-symmetric sections under flexural effects. 6.5. Concept of torsion centre. 6.6. Shear stresses on open thin-hollow sections.
7	DEFORMATIONS ON BEAMS 7.1. Differential equation of the beam under flexural behaviour. 7.2. Calculation of deflections by direct integration. 7.3. Superposition method. 7.4. Möhr theorems. 7.5. Non-prismatic beams.

8	STATICALLY INDETERMINATE BEAMS 8.1. Types of statically indeterminate beams. 8.2. Methods of analysis. 8.3. Thermal effects.
9	ENERGY METHODS 9.1. Strain energy under axial effects. 9.2. Strain energy due to torsional actions. 9.3. Strain energy produced by flexural effects. 9.4. Castigliano´s theorem. 9.5. Unit force theorem.

7. ASSESSMENT METHODS AND CRITERIA

Description	Type	Final Eval.	Reassessn	%
Every two weeks there will be a theoretical-practical test (30 minutes) dealing with the matter explained so far.	Work	No	No	10,00
There will be 2 partial exams corresponding to the blocks 1 to 5 and 6 to 9, respectively. Each of these exams consist of 2 practical or theoretical-practical problems.	Written exam	No	No	30,00
The final exam is aimed at the students who have failed any of the four problems corresponding to the partial exams so that they can retake them.	Written exam	No	Yes	60,00
TOTAL				100,00

Observations

As a general criterion and unless otherwise specified in this guide, a student can only apply for the recovery of those activities that have not passed, that is, in which he has not obtained a minimum score of five out of ten.

Observations for part-time students

Students enrolled part-time can be examined for the entire subject in the final exam, with the same requirements as the rest of the students in said exam.

8. BIBLIOGRAPHY AND TEACHING MATERIALS

BASIC

Resistencia de Materiales. James M. Gere. Editorial Thomson. ISBN 84-9732-065-4