UNIVERSIDAD DE LA RIOJA

STRENGTH OF MATERIALS
2016-2017

Bachelor Degree:	Mechanical Engineering		803G
Course title:	Strength of Materials		495
Year/Semester:	2016/2017 – 2nd Semester	ECTS Credits:	6

DEPARTMENT

Mechanical Engineering					
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ENGLISH-FRIENDLY FACULTY

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CONTENTS

UNIT 1. Introduction to Strength of Materials
Objectives and aims of Strength of Materials.
Elastic solid.
Theoretical model of solids used in Strength of Materials.
Static equilibrium and elastic equilibrium. A Short Review of the Methods of Statics.
Stresses and strains of elastic solids.
General principles of Strength of Materials.
Stress – strain relations. Stress-Strain Diagram.
True Stress and True Strain
Hooke's Law; Modulus of Elasticity
Internal forces: relations with the components of matrix of stresses.
Type of actions on an elastic solid.
Reactions in supports. Types of supports.
Determinate and indeterminate static systems.
Safety factors. Allowable stress.
Strain energy. Energetic theorems.
Yield Criteria. Equivalent stress.
Geometry of plane sections: centre of gravity, inertia moments, radius of gyration, principal axis of inertia.
Mohr's circle for moments of inertia.

UNIT 2. Tension and compression
Axial loading. Normal force. Normal stress.
Stress state of a solid under axial loading.
Strain state of a solid under axial loading.
Stresses and strains in a prismatic solid under variant axial loading.
Stresses and strains in a prismatic solid caused by self-weight.
Expression of the strain energy of a prismatic solid under axial loading.
Statin indeterminate tension and compression.
Tension and compression caused by temperature variations.
Biaxial tension and compression. Stresses in Thin-Walled Pressure Vessels

UNIT 3. Theory of bending: Analysis of stresses.
Introduction
Pure bending. Navier's law in pure bending.
Simple bending. Drawing of shear force and bending moment diagrams.
Relations among shear force, bending moment and loading.
Shear stress caused by shear force. Theorem of Colignon.
Principal stresses in simple bending. Mohr's circle to determine the principal stresses in bending.
Longitudinal Shear on a Beam Element of Arbitrary Shape.
Shearing Stresses in Thin-Walled Members.
Unsymmetrical Loading of Thin-Walled Members. Shear Centre.

UNIT 4. Theory of bending: Analysis of strains.
Introduction
Deformation of a beam under transverse loading
Double integration method. Equation of the elastic curve.
Method of Superposition.
Moment-Area Theorems or Mohr's theorems.
Application to Cantilever Beams and Beams with Symmetric Loadings.
Bending-Moment Diagrams by Parts.
Application of Moment-Area Theorems to Beams with Unsymmetrical Loadings
Maximum Deflection
Expression of strain energy for a prismatic solid under simple bending.
Shear section.
Method of unit load to determine deflections and rotations.

UNIT 5. Unsymmetrical bending and combination of axial force and bending moment.
Introduction
Unsymmetrical bending. Analysis of stresses.
Expression of strain energy for a prismatic solid under unsymmetrical bending. Analysis of deflections.
Combined Axial and Flexural loading.
Eccentric bending

UNIT 6. Statically indeterminate beams and frames.
Introduction.
Statically indeterminate beams.
Continuous beams.
Statically Indeterminate structures. Grade of static indeterminacy.
Force Methods applied to solve statically indeterminate structures.
Application of Castigliano's theorem to solve statically indeterminate structures.
Strains and deflections in statically indeterminate structures.
Symmetrical and antisymmetric statically indeterminate structures.

UNIT 7. Torsion
Introduction
Preliminary Discussion of the Stresses in a Shaft
Deformations in a Circular Shaft
Stresses in the Elastic Range
Angle of Twist in the Elastic Range
Statically Indeterminate Shafts
Design of Transmission Shafts
Stress Concentrations in Circular Shafts
Plastic Deformations in Circular Shafts
Circular Shafts Made of an Elastoplastic Material
Residual Stresses in Circular Shafts
Torsion of Noncircular Members
Thin-Walled Hollow Shafts
Combined Bending and Torsion.
Mohr's method to determine displacements in the case of combined bending and torsion.

UNIT 8. Columns. Buckling
Introduction
Stability of Structures
Euler's Formula for Pin-Ended Columns
Extension of Euler's Formula to Columns with Other End Conditions
Application of the Spanish Technical Code of Building to columns.

REFERENCES

Title
Mechanics of Materials 8th SI Edition by James M. Gere and Barry J. Goodno, 2013 Cengage Learning
Mechanics of Materials 7th Edition by Ferdinand Beer, E. Russell Johnston, Jr., John DeWolf and David Mazurek, 2015, McGraw Hill
Mechanics of Materials, 9th Edition by Russell C. Hibbeler ©2014, Pearson
Mechanics of Materials, 3rd Edition SI Version by Timothy A. Philpot, 2013, Wiley
Intermediate Mechanics of Materials, 2nd Edition by J. R. Barber, 2010 Springer.
Applied Strength of Materials, Fifth Edition by Robert L. Mott, 2007, CRC Press
A TEXTBOOK OF STRENGTH OF MATERIALS, Sixth Edition, by Dr. R. K. Bansal 2017, Laxmi Publications

EVALUATION SYSTEM

The evaluation consist in three parts with these weights:
Written exam 60%
Works and projects 20%
Memory of Lab practice 20%

It is necessary to obtain at least a 40% in the written exam to do the weighting sum of marks

It is necessary to obtain at least 50% of the points in the weighting sum to pass the course