

STRENGTH OF MATERIALS 2016-2017

Bachelor Degree:	Industrial Electronics and Automation Engineering	803G
Course title:	Strength of Materials	495
Year/Semester:	2016/2017 – 2 nd 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