Program : **Diploma inMechanical Engineering/Tool and Die Engineering/ManufacturingTechnology/Wood and Paper Technology**	
Course Code :**3021**	Course Title: **Strength ofMaterials**
Semester : **3/3/3/4**	Credits: **3/3/3/No Credit**
Course Category: **Program Core**	
Periods per week: **3 (L:2,T:1,P:0)**	Periods per semester:**45**

CourseObjectives:

- To develop understanding of the basic concepts related to tensile, compressive and shear stresses in engineering components.
- To Show the concept of Shear Force and Bending Moment Diagrams.
- To Explain the concept of theory of Simple Bending and Deflection of Beams.
- To discuss the basic principles of Torsion in Shafts and springs and to provide basic knowledge in stresses developed in Thin Cylindrical Shells.

Course Prerequisites:

Topic	Courseco de	Course name	Semester
Basic Mathematics		Mathematics I & II	1& 2
Basic Physics		Applied Physics I & II	1&2
Basic concepts of mechanics		Engineering Mechanics	2

Course Outcomes:

On completion of the course, the student will be able to:

COn	Description	Duration (Hours)	Cognitive Level
CO 1	Explain stress and strain values and find the changes in axial, lateral and volumetric dimensions. Find thermal stresses in bodies of uniform section and composite sections.	10	Understanding
CO 2	Solve the shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of UDL and Point loads.	13	Applying

CO 3	Show the deflection of beams, theory of columns and struts.	10	Understanding
CO 4	Comparison of solid and hollow shafts, define and solve the stress and deflection of the closed coil helical spring. Illustratethe stresses on thin cylinders.	10	Understanding
	Series Test	2	

CO – PO Mapping:

Course Outcomes	PO1	PO2	PO3	PO4	PO5	PO6	PO7
CO1	3	2					
CO2	3	2					
CO3	3	3					
CO4	3	3					

3-Strongly mapped, 2-Moderately mapped, 1-Weakly mapped

Course Outline:

Module outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Explain stress and strain values and find the changes in axial, lateral and volumetric dimensions.Find thermal stresses in bodies of uniform section and composite sections.**		
M1.01	Explain Types of forces; Stress, Strain and their nature, Mechanicalproperties of common engineering materials.	1	Understanding
M1.02	Demonstrate the significant points on stress-strain diagram for MS and CI specimens. Illustrate the Significance of factor of safety and Relation between elastic constants.	1	Understanding
M1.03	Explain the concept of Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces.	2	Understanding
M1.04	Interpret Thermal stresses in bodies of uniform section and composite sections	2	Understanding
M1.05	Solve Related numerical problems on the above topics	4	Applying

Contents:

Simple Stresses and Strains: Types of forces (Tensile, Compressive and Shear); Stress, Strain and their nature; Mechanicalproperties of common engineering materials; Salient points on stress – strain diagram for ductile and brittle materials. Significance of factor of safety; Relation between elastic constants; Stress and strain values in bodies of uniform section and of composite section under the influence of normal forces; Thermal stresses in bodies of uniform section and composite sections; Simple numerical problems.

CO2	**Solve the shear force and bending moment at any section of beam and draw the S.F. & B.M diagrams of UDL and Point loads.**		
M2.01	Explain Types of beams with examples: a) Cantilever beam, b) Simply supported beam, c) Over hanging beam, d) Continuous beam, e) Fixed beam and Types of Loads – Point load, UDL and UVL	3	Understanding
M2.02	Summarize the Definition and explanation of shear force and bending moment.	2	Understanding
M2.03	Utilize the theory and perform the Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams by the analytical method only for the following cases: a) Cantilever with point loads, b) Cantilever with uniformly distributed load, c) Simply supported beam with point loads, d) Simply supported beam with UDL, e) Combination of point and UDL for the above	8	Understanding
	Series Test – I	1	

Contents:

Shear Force & Bending Moment Diagrams: Types of beams:

i) Cantileverbeam,
ii) Simply supported beam,
iii) Over hanging beam iv) Continuous beam and
iv) Fixed beam;

Types of Loads – Point load, UDL and UVL; Definition and explanation of shear force and bending moment; Calculation of shear force and bending moment and drawing the S.F and B.M. diagrams for the following cases:

i) Cantilever with point loads,
ii) Cantilever with uniformly distributed load,
iii) Simply supported beam with point loads,
iv) Simply supported beam with UDL and
v) Combination of point and UDL for the above cases; Simple numerical problems.

CO3	**Show the deflection of beams, theory of columns and struts.**		
M3.01	Explain the theory of bending and explain the terms Neutral layer, Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature.	2	Understanding
M3.02	Illustrate the bending equation and discuss the assumptions for it.	2	Understanding
M3.03	Solve Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross- section.	2	Applying
M3.04	Interpret the Definition and explanation of deflection as applied to beams. Define the Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only) Solve problems for deflection of beams.	2	Understanding
M3.05	Column and struts. Develop the terms buckling load, effective length, and slenderness ratio. State Euler's formulae and Rankine's formula. Solve the slenderness ratio, equivalent length and buckling load on columns using the two formulae under different end conditions.	2	Applying

Contents:

Theory of Simple Bending and Deflection of Beams: Explanation of terms: Neutral layer,Neutral Axis, Modulus of Section, Moment of Resistance, Bending stress, Radius of curvature; Assumptions in theory of simple bending; Bending Equation $M/I = \sigma/Y = E/R$ with derivation; Problems involving calculations of bending stress, modulus of section and moment of resistance; Calculation of safe loads and safe span and dimensions of cross-section; Definition and explanation of deflection as applied to beams; Deflection formulae without proof for cantilever and simply supported beams with point load and UDL only (Standard cases only); Simple numerical problems.

Columns and struts

Introduction - column- strut- buckling load- equivalent length- slenderness ratio - types of columns - short column- medium size column- long column - Euler's equations and its assumption for crippling load for different end conditions (no proof) use of formulae - both end hinged -one end is fixed and other is free- one end is fixed and other is hinged- both ends fixed-equivalent length - Rankine's formulae for columns - simple problems on columns to calculate buckling load- slenderness ratio- equivalent length on different end conditions.

CO4	**Comparison of solid and hollow shafts, define and solve the stress and deflection of the closed coil helical spring. Illustratethe stresses on thin cylinders.**		
M4.01	Explain the Definition and function of shaft; Perform the Calculation of polar M.I. for solid and hollow shafts	3	Understanding
M4.02	Identify the effect of forces on spring, illustrate the expressions for deflection, stiffness, torque, and energy stored in the spring. Solve the stress induced diameter, deflection, and stiffness of closely coiled helical spring subjected to axial loads.	4	Understanding
M4.03	State the failure of thin cylindrical shell due to an internal pressure. Identify the stresses in a thin cylinder subjected to an internal pressure. Solve the thickness of cylinder.	3	Understanding
	Series Test – II	1	

Contents:

Torsion in Shafts and Springs: Definition and function of shaft; Calculation of polar M.I. forsolid and hollow shafts; Assumptions in simple torsion; Derivation of the equation T/J=fs/R=Gθ/L; Problems on design of shaft based on strength and rigidity; comparison of strength and weight of solid and hollow shafts; Classification of springs; Nomenclature of closed coil helical spring; Deflection formula for closed coil helical spring (without derivation); stiffness of spring; Numerical problems on closed coil helical spring to find safe load, deflection, size of coil and number of coils.

Thin Cylindrical Shells: Explanation of longitudinal and hoop stresses in the light of circumferential and longitudinal failure of shell; Expressions for the longitudinal and hoop stress; Simple numerical Problems for safe thickness and safe working pressure.

Text / Reference:

T/R	Book Title/Author
T1	Strength of Materials - Dr. R.K.Bansal, Lakshmi Publishers
T2	Strength of Materials - R.S. Khurmi, S.Chand& Company Ltd
R1	Strength of materials – SS BhavikattiVikas Publishing House
R2	Strength of Materials - Ramamrutham, Dhanpat rai & sons
R3	Strength of Materials- T.D. Gunneswara Rao, Cambridge University Press

Online Resources:

Sl.No	Website Link
1	https://mechanicalc.com/reference/strength-of-materials
2	https://www.springer.com/journal/11223
3	https://nptel.ac.in/courses/112/107/112107146/
4	https://www.sciencedirect.com/topics/materials-science/strength-of-materials