Program : **Diploma in Architecture / Civil Engineering**	
Course Code : **3014**	Course Title: **Theory of structures**
Semester : **3**	Credits: **4**
Course Category: **Program Core**	
Periods per week: **4 (L:3, T: 1, P: 0)**	Periods per semester: **60**

Course Objectives:

- To draw bending moment and shear force diagram
- To compute bending stress and shear stress in beams
- To obtain stresses in vertical members
- To analyze beams using various methods

Course Prerequisites:

Topic	Course code	Course name	Semester
Integration, Trigonometry		Engineering Mathematics	1
Stress, strain, force		Basic mechanics	2

Course Outcomes:

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

COn	Description	Duration (Hours)	Cognitive Level
CO1	Interpret shear force and bending moment diagrams for various types of beams and loading conditions.	15	Applying
CO2	Apply concept of compression member to analyse columns.	14	Applying
CO3	Compute slope and deflection of beams.	15	Applying
CO4	Analyse continuous beams with two spans.	14	Applying
	Series test	2	

CO – PO Mapping

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

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

Course Outline:

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

Module Outcomes	Description	Duration (Hours)	Cognitive Level
CO1	**Interpret shear force and bending moment diagrams for various types of beams and loading conditions and determine bending stress in beam with an outline of shear stress.**		
M1.01	Outline the concept of bending moment and shear force	3	Understanding
M1.02	Draw BMD and SFD of S-S and cantilever beams under point and UD load	5	Applying
M1.03	Outline the concept of bending and shear stresses in beams	2	Understanding
M1.04	Compute bending stress and shear stress in beams	5	Applying

Contents:

Shear Force and Bending Moment

Types of supports, beams and loads. Concept and definition of shear force and bending moment, Relation between load, shear force and bending moment (without derivation).

Shear force and bending moment diagram for cantilever and simply supported beams with overhang subjected to point loads, uniformly distributed loads. (Combination of any two types of loading), point of contra flexure.

Bending and Shear Stresses in beams

Concept and theory of pure bending, assumptions, flexural equation (without derivation), bending stresses and their nature, bending stress distribution diagram. Concept of moment of resistance and simple numerical problems using flexural equation.

Shear stress equation (without derivation), relation between maximum and average shear stress for rectangular section, circular section, I section and T section shear stress distribution diagram. Simple numerical problems

CO2	**Apply concept of compression member to analyse columns with an outline of direct and bending stresses in vertical members, dams and retaining walls**		
M2.01	Outline the concept of compression member	2	Understanding
M2.02	Apply Euler's equation and Rakine's equation to calculate buckling and crippling load	3	Applying
M2.03	Outline direct and bending stresses in vertical members	2	Understanding
M2.04	Compute maximum and minimum bending stresses in vertical members	4	Applying
M2.05	Outline dams and retaining wall	3	Applying
	Series Test – I	1	

Contents:

Columns:

Concept of compression member, short and long column, Effective length, Radius of gyration, Slenderness ratio, Types of end condition for columns, Buckling of axially loaded columns.

Euler's theory, assumptions made in Euler's theory and its limitations, Application of Euler's equation to calculate buckling load.

Rankine's formula and its application to calculate crippling load. Concept of working load/safe load, design load and factor of safety.

Direct and Bending Stresses in vertical members

Introduction to axial and eccentric loads, eccentricity about one principal axis only, nature of stresses, Maximum and minimum stresses, resultant stresses and stress diagram. Condition for no tension or zero stress at extreme fiber, Limit of eccentricity, core of section for rectangular and circular cross sections, Middle third rule.

Dams

Analysis of dams subjected to horizontal water pressure, conditions of stability, Maximum and minimum stresses, resultant stresses and distribution diagram at base. (Trapezoidal section)

Retaining wall

Angle of repose- Rankine's formula for earth pressure (without derivation). Calculate the force acting due to earth backfill without surcharge- stress at base- stress distribution diagram.

CO3	**Compute slope and deflection of beams and study of torsion.**		
M3.01	Calculate slope, deflection and stiffness of beams	3	Applying
M3.02	Compute the slope and deflection using moment area method for cantilever and S-S beams	4	Applying

M3.03	Apply torsion equation	3	Applying
M3.04	Calculate fixed end moments and reactions by applying standard formulae and draw SFD and BMD	5	Applying

Slope and Deflection

Concept of slope and deflection, stiffness of beams, relation among bending moment, slope, deflection and radius of curvature, (no derivation).

Moment area method for slope and deflection of beams – Mohr's theorems – problems for finding the slope and deflection of cantilever beams with point load, UD. Load and combinations of point and UD. Load. Simply supported beam with point load, UD. Load and combinations of point and UD. Load. [symmetrical load Only]

Fixed Beam

Concept of fixity, effect of fixity, advantages and disadvantages of fixed beam over simply supported beam. Principle of superposition, Fixed end moments from first principle for beam subjected to point load, UDL over entire span. Application of standard formulae in finding end moments, end reactions and drawing S.F. and B.M. diagrams for a fixed beam.

Torsion of circular shaft, Torsion equation, Power transmission capacity of shaft, Stress variation across the cross section of shaft.

CO4	**Apply Clapeyron's theorem and moment distribution method to continuous beams with two spans**		
M4.01	Outline the concept of continuous beams	1	Understanding
M4.02	Compute moments and reactions by applying Clapeyron's 3 moment theorem of continuous beams with two spans and draw SFD and BMD	4	Applying
M4.03	Compute bending moment and reactions for continuous beams with two spans and two support reaction using moment distribution method and draw BMD and SFD.	5	Applying
M4.04	Outline portal frames with the concept of bays and stories.	4	Understanding
	Series Test – II	1	

Contents:

Continuous beams and moment distribution method

Definition, effect of continuity, nature of moments induced due to continuity, concept of deflected shape, practical examples.

Clapeyron's theorem of three moment (no derivation), Application of Clapeyron's theorem with two spans and two unknown support moment only, Support at same level spans having same and uniform moment of inertia subjected to concentrated loads and uniformly distributed loads over entire span. Draw SF diagrams and BM diagrams showing point of contra flexure for continuous beams.

Moment distribution method

Introduction to moment distribution method, sign convention, Carry over factor, stiffness factor, distribution factor.

Application of moment distribution method to various types of continuous beams subjected to concentrated loads and uniformly distributed load over entire span having same moment of inertia, supports at same level, up to two spans and two unknown support moments only.

Introduction to portal frames – Symmetrical and unsymmetrical portal frames with the concept of Bays and stories.

Text / Reference:

T/R	Book Title/Author
T1	Punmia B C, Strength of Materials, Laxmi Publications (p) Ltd. New Delhi. 6
T2	Bedi D.S., Strength of Materials, Khanna Publishing House, Delhi
T3	Khurmi, R.S., Strength of Materials, S Chand and Co. Ltd. New Delhi
T4	Ramamurtham, S, Strength of Materials, Dhanpat Rai and sons, New Delhi.
T5	Ramamrutham.S, Theory of structures, Dhanpatrai & Sons.
T6	Khurmi, R. S., Theory of Structures S. Chand and Co., New Delhi.
T7	Bhavikatti, S S, Structural Analysis Vol-1, Vikas Publishing House Pvt Ltd. New Delhi.
R1	Rattan S.S., Strength of Materials, McGraw Hill Education; New Delhi
R2	Junnarkar, S. B., Mechanics of structures, Volume-I and II Charotar Publishing House, Anand
R3	Pandit, G.S. and Gupta, S.P., Theory of Structures, Tata McGra

Online Resources:

Sl.No	Website Link
1	https://www.nptel.ac.in