GOVERNMENT POLYTECHNIC, BALANGIR

DEPARTMENT OF CIVIL ENGINEERING

LESSION PLAN

SESSION 2023-24

SUBJECT: STRUCTURAL MECHANICS	BRANCH: CIVIL ENGINEERING
NAME OF THE FACULTY: SOURAV KU. BEHERA	SEMESTER: 3rd
SESSION STARTS FROM	1th AUGUST TO 9TH DECEMBER 2023

SL NO.	CHAPTER	HOURS	LECTURE NO.	TOPIC TO BE COVERED
1	CHAPTER 01	04		Review of Basic Concepts
			1	Basic Principle of Mechanics: Force, Moment.
			2	Support conditions, Conditions of equilibrium
			3	C.G & MI, Free body diagram
			4	Review of CG and MI of different sections
2	CHAPTER 02	15		Simple and Complex Stress, Strain
			1	Introduction to stresses and strains, Types of stresses -Tensile, Compressive and Shear stresses, Types of strains - Tensile, Compressive and Shear strains.
			2	Complimentary shear stress - Diagonal tensile / compressive Stresses due to shear.
			3	Mechanical properties of materials – Rigidity, Elasticity, Plasticity, Compressibility, Hardness, Toughness, Stiffness, Brittleness, Ductility, Malleability, Creep, Fatigue, Tenacity, Durability
			4	Poisson's Ratio, Volumetric strain, computation of stress, strain, change in dimensions and volume etc.
			5	Hooke's law - Elastic Constants, Derivation of relationship between the elastic constants.
			6	Numerical Problem Practice of Simple Stresses and Strains
			7	Behaviour of ductile and brittle materials under direct loads
			8	Stress Strain curve of a ductile material, Limit of proportionality, Elastic limit, Yield stress, Ultimate stress, Breaking stress,
			9	Stress Strain curve of a ductile material, Limit of proportionality, Elastic limit, Yield stress, Ultimate stress, Breaking stress,
			10	Percentage elongation, Percentage reduction in area, Significance of percentage elongation and reduction in area of cross section
			11	Deformation of prismatic bars due to uniaxial load, Deformation of prismatic bars due to its self-weight
			12	Principal stresses and strains: Occurrence of normal and tangential stresses

				13	Concept of Principal stress and Principal Planes, major and minor principal stresses and their orientations
				14	Mohr's Circle and its application to solve problems of complex stresses
				15	Numerical Problem Practice of Complex Stresses and Strains
3	CHAPTER 03	10			**Stresses In Beams and Shafts**
				1	Bending stress in beams – Theory of simple bending – Assumptions – Moment of resistance.
				2	Equation for Flexure– Flexural stress distribution – Curvature of beam
				3	Position of N.A. and Centroidal Axis –Flexural rigidity – Significance of Section modulus.
				4	Shear stress distribution in beams of rectangular and circular section.
				5	Shear stress distribution of standard sections symmetrical about vertical axis.
				6	Concept of torsion, basic assumptions of pure torsion, torsion of solid and hollow circular sections, polar moment of inertia
				7	Torsional shearing stresses, angle of twist, torsional rigidity, equation of torsion.
				8	Combination of stresses, combined direct and bending stresses, Maximum and Minimum stresses in Sections, Conditions for no tension.
				9	Combination of stresses, combined direct and bending stresses, Maximum and Minimum stresses in Sections, Conditions for no tension.
				10	Limit of eccentricity, Middle third/fourth rule, Core or Kern for square, rectangular and circular sections, chimneys, dams and retaining walls.
4	CHAPTER 04	04			**Columns and Struts**
				1	Columns and Struts, Definition, Short and Long columns.
				2	End conditions, Equivalent length / Effective length, Slenderness ratio.
				3	Axially loaded short and long column, Euler's theory of long columns.
				4	Critical load for Columns with different end conditions.
5	CHAPTER 05	12			**Shear Force and Bending Moment**
				1	Types of Loads: Concentrated (or) Point load, Uniformly Distributed load (UDL).
				2	Types of Supports: Simple support, Roller support, Hinged support, Fixed support.
				3	Types of Reactions: Vertical reaction, Horizontal reaction, Moment reaction.
				4	Types of Beams based on support conditions.
				5	Calculation of support reactions using equations of static equilibrium.
				6	Signs Convention for S.F. and B.M

				7	S.F and B.M of general cases of determinate beams with concentrated loads.
				8	S.F and B.M of general cases of determinate beams with UDL.
				9	S.F and B.M diagrams for Cantilevers
				10	S.F and B.M diagrams for Simply supported beams and over hanging beams.
				11	Position of maximum BM, Point of contra flexure.
				12	Relation between intensity of load, S.F and B.M.
6	CHAPTER 06	10			Slope and Deflection
				1	Shape and nature of elastic curve.
				2	Relationship between slope, deflection and curvature.
				3	Relationship between slope, deflection and curvature.
				4	Importance of slope and deflection.
				5	Slope and deflection of cantilever under concentrated and UDL using Double Integration method.
				6	Slope and deflection of cantilever under concentrated and UDL using Double Integration method
				7	Slope and deflection of simply supported beam under concentrated and UDL using Double Integration method.
				8	Slope and deflection of simply supported beam under concentrated and UDL using Double Integration method.
				9	Slope and deflection by using Macaulay's method.
				10	Slope and deflection by using Macaulay's method.
7	CHAPTER 07	10			Indeterminate Beams
				1	Stability, determinacy and indeterminacy
				2	Stability, determinacy and indeterminacy
				3	Principle of consistent deformation/compatibility
				4	Principle of consistent deformation/compatibility
				5	Principle of superposition
				6	Analysis of propped cantilever
				7	Analysis of propped cantilever
				8	Analysis of fixed and two span continuous beams
				9	Analysis of fixed and two span continuous beams

			10	SF and BM diagrams (point load and UDL covering full span)
8	CHAPTER 08	10		Trusses
			1	Types of trusses
			2	Analysis of statically determinate trusses
			3	Analysis of statically indeterminate trusses
			4	Analysis of statically indeterminate trusses
			5	Degree of indeterminacy
			6	Degree of indeterminacy
			7	Stable and unstable trusses
			8	Stable and unstable trusses, advantages of trusses
			9	Analytical method (Method of joints, method of Section)
			10	Analytical method (Method of joints, method of Section)