STRENGTH OF MATERIALS – II

III Semester: CE

Course Code	Category	Hours / Week			Credits	Maximum Marks		
		L	T	P	C	CIA	SEE	Total
ACE004	Core	3	1	-	4	30	70	100
Contact Classes: 45	Tutorial Classes: 15	Practical Classes: Nil				Total Classes: 60		

OBJECTIVES:

The course should enable the students to:

I. Apply the concepts of strain energy and virtual work to calculate deflections in beams.
II. Discuss about springs and their various types of combination connections.
III. Outline of columns and struts with different end conditions and awareness about laterally loaded struts.
IV. Understand direct and bending stresses in concrete structures like retaining wall, chimney and dams.

COURSE LEARNING OUTCOMES (CLOs):

1. Calculate the slope and deflection for cantilever and simply supported beams under various loads.
2. Understand the different methods for deflection of beams with constant and variable moment of inertia.
3. Predict the differential equation for the elastic line of a beam.
4. Apply Mohr's theorems and moment area methods for simple cases including overhanging beams.
5. Understand the concept of conjugate beam method.
6. Analyze the strain energy under gradual, sudden, impact and shock loadings simple applications.
7. Apply Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force.
8. Understand the energy methods like work energy method, principal of virtual work, unit load method and Castigliano's theorem.
9. Evaluate the deflections of simple beams and pin jointed trusses and concept extended to frames and indeterminate structures.
10. Analyze structures using Maxwell's theorem of reciprocal deflections and betti's Law.
11. Understand the concept of thin seamless cylindrical shells.
12. Derive the formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetrical strains.
13. Analyze Lames theory for thick cylinders.
14. Derive the derivation of lames formulae and distribution of hoop and radial stresses across thickness.
15. Evaluate thick cylinders and compound cylinders for necessary difference of radii under shrinkage and thick spherical shells.
16. Analyze propped cantilever and fixed beams using different methods.
17. Derive the propped cantilever and fixed beams under various conditions.
18. Calculate the deflection of propped cantilever and fixed beams.
19. Understand the effect of rotation of a support.
20. Explain clapeyron's theorem of three moments.
21. Analyze continuous beams with constant and variable moments of inertia.
22. Analyze the continuous beam with overhangs.
23. Calculate the Effects of sinking of supports.

Unit-I	DEFLECTIONS OF BEAMS	Classes: 09

Bending into a circular arc, slope, deflection and radius of curvature, differential equation for the elastic line of a beam, double integration and Macaulay's methods, determination of slope and deflection for

cantilever and simply supported beams subjected to various loads, Mohr's theorems, moment area method, application to simple cases including overhanging beams; Conjugate beam method, concept of conjugate beam method, difference between a real beam and a conjugate beam, deflections of determinate beams with constant and different moments of inertia.\

Unit -II	DEFLECTIONS BY ENERGY METHODS	Classes: 09

Strain Energy: Resilience gradual, sudden, impact and shock loadings simple applications; Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear force; Energy Methods: Work energy method, principal of virtual work, unit load method, Castigliano's theorem; Deflections of simple beams and pin jointed trusses; Concept extended to frames and indeterminate structures; Maxwell's theorem of reciprocal deflections; Betti's Law.

Unit -III	STRESSES IN CYLINDERS AND SPHERICAL SHELLS	Classes: 09

Thin seamless cylindrical shells, derivation of formula for longitudinal and circumferential stresses, hoop, longitudinal and volumetrical strains, changes in diameter and volume of thin cylinders, thin spherical shells. Lames theory for thick cylinders, derivation of lames formulae, distribution of hoop and radial stresses across thickness, design of thick cylinders, compound cylinders, necessary difference of radii for shrinkage, thick spherical shells.

Unit -IV	INDETERMINATE BEAMS: PROPPED CANTILEVER AND FIXED BEAMS	Classes: 09

Analysis of propped cantilever and fixed beams using the method of consistent deformation, including the beams with varying moments of inertia, subjected to uniformly distributed load, central point load, eccentric point load, number of point loads, uniformly varying load, couple and combination of loads, shear force and bending moment diagrams for propped cantilever and fixed beams, deflection of propped cantilever and fixed beams; Effect of rotation of a support.

Unit -V	INDETERMINATE BEAMS: CONTINUOUS BEAMS	Classes: 09

Continuous beams, Clapeyron's theorem of three moments, analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed, continuous beams with overhang; Effects of sinking of supports.

Text Books:

1. R. K. Bansal, "A Textbook of Strength of Materials", Laxmi Publications (P) Ltd., New Delhi, 2nd Edition, 2007.
2. F. Beer, E. R. Johnston, J. DeWolf , "Mechanics of Materials", Tata McGraw-Hill Publishing Company Ltd., New Delhi, India, 1st Edition, 2008.
3. S. S. Bhavikatti, "Strength of Materials", Vikas Publishing House Pvt. Ltd., New Delhi, 5th Edition, 2013.

Reference Books:

1. B. C. Punmia, Ashok K Jain and Arun K Jain, "Mechanics of Materials", Laxmi Publications Pvt. Ltd., New Delhi, 12th Edition, 2007.
2. R. Subramanian, "Strength of Materials", Oxford University Press, 2nd Edition, 2010.
3. D. S. Prakash Rao, "Strength of Materials A Practical Approach Vol.1", Universities Press (India) Pvt. Ltd., India, 3rd Edition, 2007.
4. J. M. Gere, S.P. Timoshenko, "Mechanics of Materials, SI units edition", CL Engineering, USA, 5th Edition, 2000.
5. E. G. Popov, "Engineering Mechanics of Solids", Pearson Education, India, 21st Edition, 2015.