Course Coordinator **RAJAMOHAN REDDY**	**E2 – SEM II**	L	T	P	C
	CE: structural analysis	3	1	0	4
	Contact hours:60				

Course objectives:

1. Illustrate the basic concepts of structural stability, static and kinematic indeterminacy.
2. Define strain energy, determine deflections using strain energy.
3. Evaluate forces and deflections in beams, frames and trusses by force methods.
4. Demonstrate the development of slope deflection equations and to solve application to continuous beams with and without settlement of supports.
5. Illustrate the concepts of moving loads and influence lines are imparted for assessment of maximum SF and BM at a given section when loads of varying spans rolling loads of Pratt and Warren trusses
6. Interpretation of Plastic analysis of structural elements

SYLLABUS

UNIT –I: Indeterminate Structural Analysis (contact hours - 14)

Indeterminate Structural Analysis –Determination of static and kinematic indeterminacies –Solution of trusses with up to two degrees of internal and external indeterminacies –Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano's first theorem-Deflections of simple beams and pin jointed trusses.

UNIT –II: Propped Cantilevers, Fixed Beams and Continuous beams (contact hours - 9)

Analysis of propped cantilevers-shear force and bending moment diagrams-Deflection of propped cantilevers, Deflection of fixed beams, effect of sinking of support, effect of rotation of a support. Clapeyron's theorem of three moments- Analysis of continuous beams with constant moment of inertia with one or both ends fixed-continuous beams with overhang, continuous beams with different moment of inertia for different spans, Effects of sinking of supports-shear force and bending moment diagrams.

UNIT III: Arches (contact hours - 8)

Three hinged arches, Elastic theory of arches – Eddy's theorem – Determination of horizontal thrust, bending moment, normal thrust and radial shear – effect of temperature. Two Hinged Arches, Determination of horizontal thrust bending moment, normal thrust and radial shear.

UNIT – IV: Slope Deflection and Moment Distribution Method (contact hours - 13)

Derivation of slope deflection equation of supports application to continuous beams including settlement of supports single bay, single sway, portal frame including side sway. Stiffness and carryover factors –Distribution factors– Analysis of continuous beams with and without sinking of supports–storey portal frames –including Sway-Substitute frame analysis by two cycle.

UNIT – V: Influence Lines: (contact hours - 8)

Definition of influence line for SF, Influence line for BM- load position for maximum SF at a section, Load position for maximum BM at a section for single point load, U.D.load longer than the span, U.D.load shorter than the span, Influence lines for forces in members of Pratt and Warren trusses.

UNIT-VI: Plastic Analysis (contact hours - 8)

Plastic Analysis: Introduction– Idealized stress– Strain diagram –shape factors for various sections– Moment curvature relationship–ultimate moment – Plastic hinge –lower an upper bound theorem –ultimate strength of fixed and continuous beams.

STRUCTURAL ANALYSIS -Lecture Plan

Lecture	Topics to be covered	Contact Hours	Reference	e-Resources	
				Video resources	Study material
	Unit -1: Indeterminate Structural Analysis	**14**			
L -1	Indeterminate Structural Analysis	1	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L -2,3	Determination of static indeterminacies	2	2,3		
L-4,5	kinematic indeterminacies	2	2,3		
L-6,7	Solution of trusses with up to two degrees of internal indeterminacies	2	2,3		
L-8,9	Solution of trusses with up to two degrees external indeterminacies	2	2,3		
L-10,11	Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces	2	2,3		
L-12	Castigliano's first theorem	1	2,3		
L-13,14	Deflections of simple beams and pin	2	2,3		

	jointed trusses				
	Unit II: Propped Cantilevers, Fixed Beams and Continuous beams	**9**			
L-15	Analysis of propped cantilevers-shear force and bending moment diagrams	1	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L-16	Deflection of propped cantilevers	1	2,3		
L-17,18	Deflection of fixed beams, effect of sinking of support	2	2,3		
L-19	Deflection of fixed beams effect of rotation of a support	1	2,3		
L-20,21	Clapeyron's theorem of three moments-Analysis of continuous beams with constant moment of inertia with one or both ends fixed-continuous beams with overhang	2	2,3		
L-22,23	Continuous beams with different moment of inertia for different spans, Effects of sinking of supports-shear force and bending moment diagrams	2	2,3		
	Unit III: Arches	**8**			
L-24	Three hinged arches	1	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L-25	Elastic theory of arches – Eddy's theorem	1	2,3		
L-26,27	Determination of horizontal thrust, bending moment, normal thrust and radial shear	2	2,3		
L-28	Three hinged arches-effect of temperature	1	2,3		

L-29	Two Hinged Arches	1	2,3		
L-30,31	Determination of horizontal thrust bending moment, normal thrust and radial shear for two hinged arches	2	2,3		
	Unit IV: Slope Deflection and Moment Distribution Method	**13**			
L-32	Derivation of slope deflection equations	1	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L-33,34	Application to continuous beams	2`	2,3		
L-35,36	Supports including settlement of supports single bay, single sway	2	2,3		
L-37	Portal frame including side sway.	1	2,3		
L-38,39	Stiffness and carryover factors – Distribution factors. Moment distribution method	2	2,3		
L-40	Analysis of continuous beams with and without sinking of supports	1			
L-41,42	Portal frames –including Sway	2			
L-43,44	Substitute frame analysis by two cycle	2	2,3		
	Unit V: influence lines	**8**			
L-45	Definition of influence line for SF, Influence line for BM,	1	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L-46	influence line load position for maximum SF at a section,	1	2,3		
L-47	influence line Load position for maximum BM at a section for single point load,	1	2,3		
L-48	influence line U.D.load longer than the span, U.D.load shorter than the span	1			

L-49,50	Influence lines for forces in members of Pratt trusses	2			
L-51,52	Influence lines for forces in members of Warren trusses	2	2,3		
	Unit VI: Plastic Analysis	**8**			
L-53,54	Plastic Analysis: Introduction Idealized stress– Strain diagram	2	2,3	https://youtu.be/s4CN6aVKhPo	https://drive.google.com/drive/u/0/folders/1tWRRGF5ZCreeyh_HIUROqjjejYqdJXJz
L-55,56	shape factors for various sections	2	2,3		
L-57	Moment curvature relationship–ultimate moment –Plastic hinge	1	2,3		
L-58	lower an upper bound theorem	1	2,3		
L-59,60	ultimate strength of fixed and continuous beams	2	2,3		

Text Books:

1. R C Hibbler," Sructural Analysis" 10th edition, 2017, Person India Publication
2. Structural Analysis-I & II (4th Edition)- S.S. Bhavikatti, Vikas Publishing House Pvt Ltd, New delhi.

References:

1. C. K. Wang, Intermediate Structural Analysis, 1st Edition, 2017, McGraw-Hill India.
2. S P Gupta and G S Pandit , Theory of Structures - Volumes 1 and 2, 1st Edition, 2017,Tata McGraw Hill.
4. Norris, Wilbur and Utku, Elementar y Structural Analysis, 4th Revised Edition, 1991, McGraHill.
5. C.S. Reddy, Basic Structural Analysis, 7th Edition, 1981, Tata McGraw Hill

Video Reference

Title	Expert Name	Affiliation	Video/Weblink
Lecture series on Structural Analysis-I	Prof. P. Devdas menon	IIT Madras	http://nptel.ac.in/courses/105101085/
Lecture note SA	Prof. LS Rama Chandra and Sudhir Kumar Barai	IIT Kharagpur	http://nptel.ac.in/downloads/105105109

COURSE OUTCOMES:

1. Distinguish between the determinate and indeterminate structures.
2. Identify the behavior of structures due to the expected loads, including the moving loads, acting on the structure.
3. Estimate the bending moment and shear forces in beams for different fixity conditions.
4. Analyze the continuous beams using various methods- slope deflection method, Moment distribution method.
5. Draw the influence line diagrams for various types of moving loads on beams/bridges.
6. Analyze the strength of structural elements using plastic analysis.

Assessment Method				
Assessment Tool	Weekly tests	Monthly tests	End Semester Test	Total
Weightage (%)	10%	30%	60%	100%