



STRUCTURAL ANALYSIS – I (CE406PC)

COURSE PLANNER

I. COURSE OVERVIEW:

Civil Engineers are required to design structures like buildings, dams, bridges, etc. This course is intended to introduce the basic principles to impart adequate knowledge and successfully apply fundamentals of Structural Engineering within their chosen engineering application area. Take advantage of a strong technical education at the undergraduate level to embark on successful professional careers in industry or to continue with a graduate education in their area of specialization. Apply broad multi-disciplinary skills necessary to accomplish professional objectives in a rapidly changing technological world.

II. PREREQUISITE(S):

Level	Credits	Periods/Week	Prerequisites
UG	3	3	Strength of Materials – I

III. COURSE OBJECTIVES:

The objective of the course is to

1. Differentiate the statically determinate and indeterminate structures.
2. To understand the nature of stresses developed in perfect frames and three hinged arches for various types of simple loads
3. Analyze the statically indeterminate members such as fixed bars, continuous beams and for various types of loading.
4. Understand the energy methods used to derive the equations to solve engineering problems
5. Evaluate the Influence on a beam for different static & moving loading positions

IV. COURSE OUTCOMES:

At the end of the course the student will able to

1. An ability to apply knowledge of mathematics, science, and engineering	Understand
2. Analyze the statically indeterminate bars and continuous beams	Analyze
3. Draw strength behavior of members for static and dynamic loading.	Understand
4. Calculate the stiffness parameters in beams and pin jointed trusses.	Apply
5. Understand the indeterminacy aspects to consider for a total structural system.	Understand
6. Identify, formulate, and solve engineering problems with real time loading	Analyze

~~V. HOW PROGRAM OUTCOMES ARE ASSESSED:~~



Program Outcomes		Level	Proficiency assessed by
PO1	An ability to apply knowledge of computing, mathematical foundations, algorithmic principles, and computer science and engineering theory in the modeling and design of computer-based systems to real-world problems (fundamental engineering analysis skills)	3	Assignments, Tutorials.
PO2	An ability to design and conduct experiments, as well as to analyze and interpret data (information retrieval skills)	3	Assignments, Tutorials, Exams.
PO3	An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs, within realistic constraints such as economic, environmental, social, political, health and safety, manufacturability, and sustainability (Creative Skills)	1.16	Assignments, Tutorials, Exams
PO4	An ability to function effectively on multi-disciplinary teams (team work)	1.16	--
PO5	An ability to analyze a problem, identify, formulate and use the appropriate computing and engineering requirements for obtaining its solution (Engineering problem solving skills)	3	Assignments, Exams
PO6	An understanding of professional, ethical, legal, security and social issues and responsibilities (professional integrity)	-	--
PO7	An ability to communicate effectively both in writing and orally (speaking / writing skills)	-	--
PO8	The broad education necessary to analyze the local and global impact of computing and engineering solutions on individuals, organizations, and society (engineering impact assessment skills)	0.5	Assignments, Exams.
PO9	Recognition of the need for, and an ability to engage in continuing professional development and life-long learning (continuing education awareness)	1	Assignments and Exams
PO10	A Knowledge of contemporary issues (social awareness)	0.5	Assignments
PO11	An ability to use current techniques, skills, and tools necessary for computing and engineering practice (practical engineering analysis skills)	1.33	Assignments and Exams
PO12	An ability to apply design and development principles in the construction of software and hardware systems of varying complexity (software hardware interface)	1	--

N-None

S-Supportive

H-High

VI. HOW PROGRAM SPECIFIC OUTCOMES ARE ASSESSED:



Program Specific Outcomes		Level	Proficiency assessed by
PSO1	UNDERSTANDING: Graduates will have an ability to understand, analyze and solve problems using basic mathematics and apply the techniques related to irrigation, structural design, etc.	2.16	Assignments, Tutorials, Exams
PSO2	ANALYTICAL SKILLS: Graduates will have an ability to design civil structures, using construction components and to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety manufacturability and reliability and learn to work with multidisciplinary teams.	2	Projects
PSO3	BROADNESS: Graduates will have an exposure to various fields of engineering necessary to understand the impact of other disciplines on civil engineering blueprints in a global, economic, and societal context and to have necessary focus for postgraduate education and research opportunities at global level.	0.5	Guest Lectures

VII. SYLLABUS:

UNIT – I

ANALYSIS OF PERFECT FRAMES:

Types of frames - Perfect, Imperfect and Redundant pin jointed plane frames - Analysis of determinate pin jointed plane frames using method of joints, method of sections and tension coefficient method for vertical loads, horizontal loads and inclined loads.

UNIT – II

ENERGY THEOREMS:

Introduction-Strain energy in linear elastic system, expression of strain energy due to axial load, bending moment and shear forces - Castigliano's theorem-Unit Load Method – Deflections of simple beams and pin- jointed plane frames - Deflections of statically determinate bent frames. THREE HINGED ARCHES – Introduction – Types of Arches – Comparison between Three hinged and Two hinged Arches - Linear Arch - Eddy's theorem – Analysis of Three hinged arches - Normal Thrust and radial shear and bending moment – Geometrical properties of parabolic and circular arches - Three hinged parabolic circular arches having supports at different levels.

UNIT - III

PROPPED CANTILEVER and FIXED BEAMS:

Determination of static and kinematic indeterminacies for beams- Analysis of Propped cantilever and fixed beams, including the beams with different moments of inertia – subjected to uniformly distributed load - point loads - uniformly varying load, couple and combination of loads - Shear force, Bending moment diagrams and elastic curve for Propped Cantilever and Fixed Beams - Deflection of Propped cantilever and fixed beams - effect of sinking of support,



effect of rotation of a support.

UNIT-IV

CONTINUOUS BEAMS:

Introduction-Continuous beams - Clapeyron's theorem of three moments Analysis continuous beams with constant and variable moments of inertia with one or both ends fixed-continuous beams with overhang - effect of sinking of supports

SLOPE DEFLECTION METHOD:

Derivation of slope-deflection equation, application to continuous beams with and without sinking of supports - Determination of static and kinematic indeterminacies for frames – Analysis of Single Bay, Single storey Portal Frames by Slope Deflection Method including Side Sway - Shear force and bending moment diagrams and Elastic curve.

UNIT – V

MOVING LOADS and INFLUENCE LINES:

Introduction maximum SF and BM at a given section and absolute maximum shear force and bending moment due to single concentrated load, uniformly distributed load longer than the span, uniformly distributed load shorter than the span, two point loads with fixed distance between them and several point loads-Equivalent uniformly distributed load Focal length – Definition of influence line for shear force and bending moment - load position for maximum shear force and maximum bending Moment at a section - Point loads, uniformly distributed load longer than the span, uniformly distributed load shorter than the span- Influence lines for forces in members of Pratt and Warren trusses - Equivalent uniformly distributed load -Focal length.

TEXT BOOKS:

1. Structural Analysis Vol –I & II by V.N. Vazirani and M.M. Ratwani, Khanna Publishers.
2. Structural Analysis Vol I & II by G.S.Pandit and S.P. Gupta, Tata McGraw Hill Education Pvt. Ltd.
3. Structural analysis T. S Thandavamoorthy, Oxford university Press

REFERENCES:

1. Structural Analysis by R. C. Hibbeler, Pearson Education
2. Basic Structural Analysis by K.U. Muthu et al., I.K. International Publishing House Pvt. Ltd
3. Mechanics of Structures Vol – I and II by H.J. Shah and S.B. Junnarkar, Charotar Publishing House Pvt. Ltd.
4. Basic Structural Analysis by C. S. Reddy., Tata McGraw Hill Education Pvt. Ltd.
5. Fundamentals of Structural Analysis by M.L. Gamhir, PHI Learning Pvt. Ltd

NPTEL WEB COURSE:

<http://nptel.ac.in/courses/105104101/>

NPTEL VIDEO COURSE:

<http://nptel.ac.in/courses/105104101/#>

RELEVANT SYLLABUS FOR GATE



Analysis of statically determinate trusses, arches, beams, cables and frames, displacements in statically determinate structures and analysis of statically indeterminate structures by force/energy methods, analysis by displacement methods (slope deflection and moment distribution methods), influence lines for determinate and indeterminate structures. Basic concepts of matrix methods of structural analysis.

RELEVANT SYLLABUS FOR IES

Analysis of determinate structures - different methods including graphical methods. Analysis of indeterminate skeletal frames - moment distribution, slope-deflection, stiffness and force methods, energy methods, Muller-Breslau principle and application. Plastic analysis of indeterminate beams and simple frames - shape factors.

VIII. COURSE PLAN:

Lect ure No.	Unit	DATE	Topics to be covered	Link for PP T	Link for PDF	Course learning outcomes	Teachi ng Metho doly	Refere nces
1.	1		ANALYSIS OF PERFECT FRAMES: Types of frames	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand about the frames	PPT/ PDF	R1, R2, R3
2.			Perfect, Imperfect, Redundant pin jointed plane frames	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand perfect, imperfect, pin jointed frames	PPT/ PDF	R1, R2, R3
3.			Analysis of determinate pin jointed plane frames using method of joints	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Understanding support reactions	PPT/ PDF	R1, R2, R3
4.			Student Presentation			Able to communicate	PPT/ PDF	R1, R2, R3
5.			method of sections	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Understanding support reactions	PPT/ PDF	R1, R2, R3



6.		tension coefficient method for vertical loads, horizontal loads and inclined loads.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Understanding support reactions	PPT/ PDF	R1, R2, R3
7.		tension coefficient method for vertical loads, horizontal loads and inclined loads.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Understanding support reactions	PPT/ PDF	R1, R2, R3
8.		Student Presentation			Able to communicate	PPT/ PDF	R1, R2, R3
9.		tension coefficient method for vertical loads, horizontal loads and inclined loads.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Understanding support reactions	PPT/ PDF	R1, R2, R3
10.	2	ENERGY THEOREMS: Introduction- Strain energy in linear elastic system	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Relation between stress strains in linear elastic system	PPT/ PDF	R1, R2, R3
11.		expression of strain energy due to axial load, bending moment and shear forces	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Stress & strain relation due to axial load	PPT/ PDF	R1, R2, R3
12.		Student Presentation			Able to communicate	PPT/ PDF	R1, R2, R3
13.		Castigliano's theorem	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand castigliano's theorem	PPT/ PDF	R1, R2, R3
14.		Unit Load Method	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand Unit Load Method	PPT/ PDF	R1, R2, R3



				ing				
15.			Deflections of simple beams and pin- jointed plane frames	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand deflections in simple and pin jointed frames	PPT/ PDF	R1, R2, R3
16.			Student Presentation			Able to communicate	PPT/ PDF	R1, R2, R3
17.			Deflections of statically determinate bent frames	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand Deflections of statically determinate bent frames	PPT/ PDF	R1, R2, R3
18.			THREE HINGED ARCHES – Introduction – Types of Arches	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about arches	PPT/ PDF	R1, R2, R3
19.			Comparison between Three hinged and Two hinged Arches - Linear Arch	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about Comparison between Three and Two & linear hinged Arches	PPT/ PDF	R1, R2, R3
20.			Comparison between Three hinged and Two hinged Arches - Linear Arch	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about Comparison between Three and Two & linear hinged Arches	PPT/ PDF	R1, R2, R3



21.		Eddy's theorem	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand eddy's theorem	PPT/ PDF	R1, R2, R3
22.		Analysis of Three hinged arches	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand three hinged arches analysis	PPT/ PDF	R1, R2, R3
23.		Normal Thrust and radial shear and bending moment	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To analyze three hinged arches	PPT/ PDF	R1, R2, R3
24.		Student Presentation			Able to communicate	PPT/ PDF	R1, R2, R3
25.		Geometrical properties of parabolic and circular arches	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand Geometrical properties of parabolic and circular arches	PPT/ PDF	R1, R2, R3
26.		Three hinged parabolic circular arches having supports at different levels.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Analysis of three hinged arches	PPT/ PDF	R1, R2, R3
27.		Three hinged parabolic circular arches having supports at different levels.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Analysis of three hinged arches	PPT/ PDF	R1, R2, R3



28.			Three hinged parabolic circular arches having supports at different levels	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Analysis of three hinged arches	PPT/ PDF	R1, R2, R3
29.	3		UNIT - III PROPPED CANTILEVER and FIXED BEAMS: Determination of static and kinematic indeterminacies for beams	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To determine static and kinematic indeterminacies of beams	PPT/ PDF	R1, R2, R3
30.			Analysis of Propped cantilever	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of propped cantilever	PPT/ PDF	R1, R2, R3
31.			fixed beams, including the beams with different moments of inertia	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know fixed beams and beams with different moments of inertia	PPT/ PDF	R1, R2, R3
		I mid exams						
32.			subjected to uniformly distributed load - point loads - uniformly varying load	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about UDL and point loads, UVL	PPT/ PDF	R1, R2, R3



33.			subjected to uniformly distributed load - point loads - uniformly varying load	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about UDL and point loads, UVL	PPT/ PDF	R1, R2, R3
34.			couple and combination of loads - Shear force, Bending moment diagrams	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about couple, SF, BM	PPT/ PDF	R1, R2, R3
35.			elastic curve for Propped Cantilever and Fixed Beams	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand elastic curves	PPT/ PDF	R1, R2, R3
36.			Student Presentation	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing		PPT/ PDF	R1, R2, R3
37.			Deflection of Propped cantilever and fixed beams -	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand deflection in PCB, FB	PPT/ PDF	R1, R2, R3
38.			effect of sinking of support, effect of rotation of a support.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about effect of sinking, rotation	PPT/ PDF	R1, R2, R3
39.			effect of sinking of support, effect of rotation of a support.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To know about effect of sinking, rotation	PPT/ PDF	R1, R2, R3
40.	4		UNIT – IV CONTINUOUS BEAMS: Introduction- Continuous beams	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand continuous beams	PPT/ PDF	R1, R2, R3
41.			Clapeyron's theorem of three moments	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand clapeyron's theorem	PPT/ PDF	R1, R2, R3



				ing				
42.			Analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of CB	PPT/ PDF	R1, R2, R3
43.			Analysis of continuous beams with constant and variable moments of inertia with one or both ends fixed	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of CB	PPT/ PDF	R1, R2, R3
44.			Student Presentation	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Able to Communicate	PPT/ PDF	R1, R2, R3
45.			continuous beams with overhang - effect of sinking of supports.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of CB with effect of sinking supports	PPT/ PDF	R1, R2, R3
46.			SLOPE DEFLECTION METHOD: Derivation of slope	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand derivation of slope	PPT/ PDF	R1, R2, R3
47.			deflection equation	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand derivation of deflection	PPT/ PDF	R1, R2, R3
48.			application to continuous beams with and without sinking of supports	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of CB	PPT/ PDF	R1, R2, R3



49.			Determination of static and kinematic indeterminacies for frames	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of frames for static and KI	PPT/ PDF	R1, R2, R3
50.			Analysis of Single Bay, Single storey Portal Frames by Slope Deflection Method including Side Sway	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of frames with side sway	PPT/ PDF	R1, R2, R3
51.			Shear force and bending moment diagrams and Elastic curve.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand analysis of frames of SF, BM, E C	PPT/ PDF	R1, R2, R3
52.			Student Presentation	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	Able to Communicate	PPT/ PDF	R1, R2, R3
53.	5		INFLUENCE LINES: Introduction	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing		PPT/ PDF	R1, R2, R3
54.			maximum SF and BM at a given section	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM	PPT/ PDF	R1, R2, R3
55.			absolute maximum shear force and bending moment due to single concentrated load	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM for single concentrated load	PPT/ PDF	R1, R2, R3



56.		uniformly distributed load longer than the span and shorter than span	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM for UDL	PPT/ PDF	R1, R2, R3
57.		two point loads with fixed distance between them and several point loads	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand two point loads with fixed distance	PPT/ PDF	R1, R2, R3
58.		Equivalent uniformly distributed load Focal length	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM for EDL	PPT/ PDF	R1, R2, R3
59.		Definition of influence line for shear force and bending moment - load position for maximum shear force and maximum bending Moment at a section -	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM at a section	PPT/ PDF	R1, R2, R3
60.		uniformly distributed load	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM at UD load with longer span	PPT/ PDF	R1, R2, R3
61.		Influence lines for forces in members of Pratt and Warren trusses -	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM at UD load with shorter span	PPT/ PDF	R1, R2, R3



62.			Equivalent uniformly distributed load - Focal length.	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	https://drive.google.com/drive/folders/1IvaJYQiMejwaSh4dUPBQ2jc1d5yqV77e?usp=sharing	To understand max SF&BM at UV load	PPT/ PDF	R1, R2, R3
-----	--	--	---	---	---	------------------------------------	----------	------------

IX. MAPPING COURSE OUTCOMES LEADING TO THE ACHIEVEMENT OF PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES:

CO's	Program Outcomes												Program Specific Outcomes		
	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	3	3	1	2	3	-	-	1	1	-	3	2	3	2	1
CO2	3	3	1	1	3	-	-	-	2	1	-	2	2	2	-
CO3	3	3	1	1	3	-	-	-	-	-	2	1	2	2	-
CO4	3	3	2	1	3	-	-	1	1	-	3	3	2	2	-
CO5	3	3	1	1	3	-	-	-	1	1	-	-	2	2	1
CO6	3	3	1	1	3	-	-	1	1	1	-	-	2	2	1
AVG	3	3	1.16	1.16	3	-	-	0.5	1	0.5	1.33	1	2.16	2	0.5

Small(S)-1

Medium(M)-2

High(H)-3

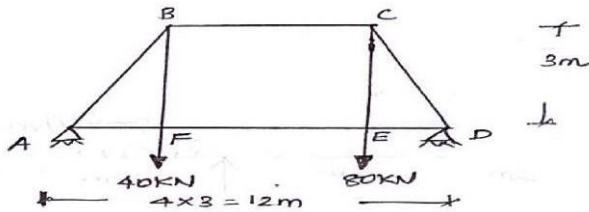
X. QUESTION BANK: (JNTUH)

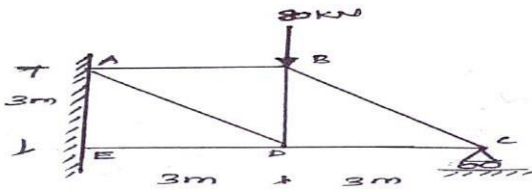
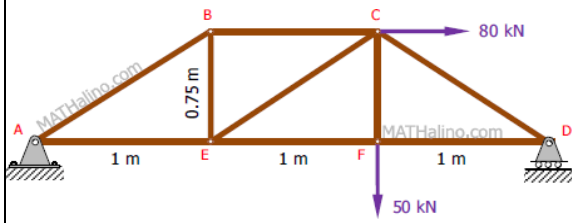
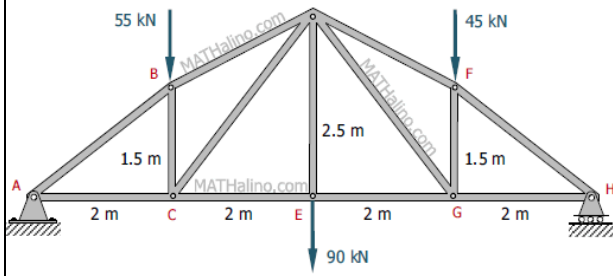
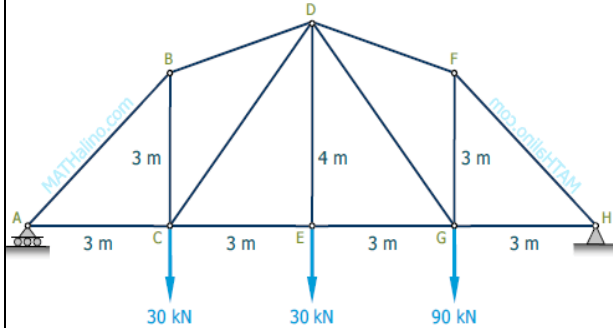
UNIT – I

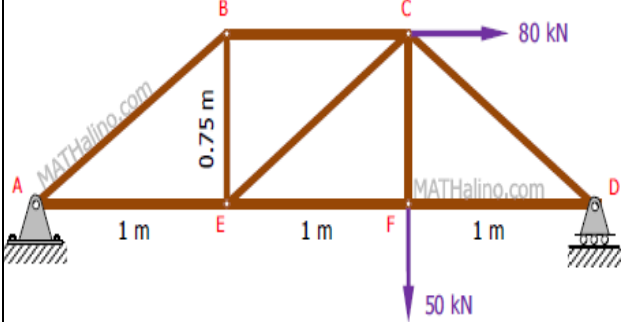
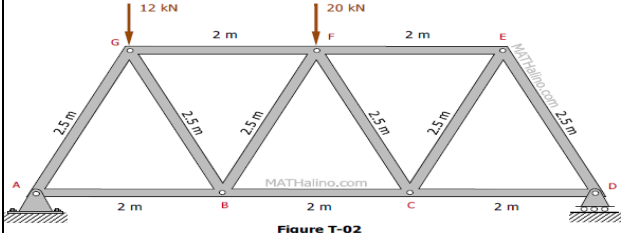
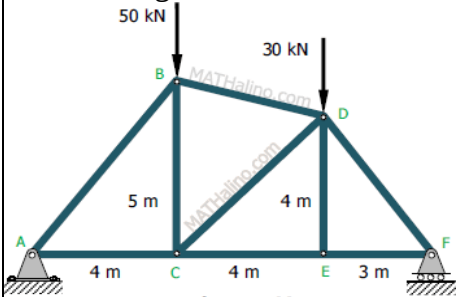
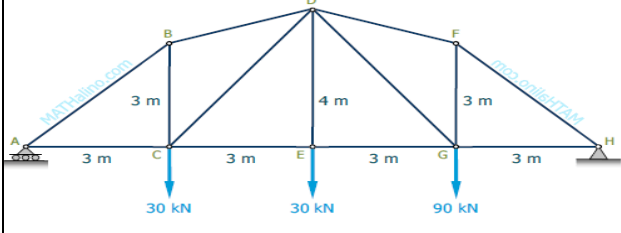
SHORT ANSWER QUESTIONS.

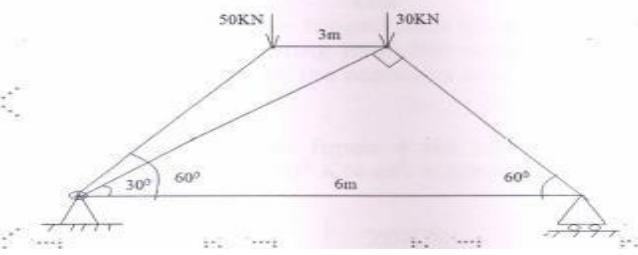
S.No	Question	Blooms Taxonomy Level	Program Outcome
1.	Explain types of frames. Perfect, Imperfect and Redundant frames?	Understanding	1
2.	Define frame?	Understanding	1
3.	What is equilibrium of plane frames?	Understanding & remembering	1
4.	Explain Methods of analysis of Determinate pin jointed frames?	Understanding & remembering	1
5.	What is the procedure for analysis of frame using Method of section?	Understanding & remembering	1
6.	What is the procedure for analysis of frame using Method of joints?	Understanding & remembering	1
7.	How to analyse the frame using Method of Tension coefficient method?	Understanding & remembering	1
8.	How to analyse the frame for vertical, horizontal and inclined loads?	Understanding & remembering	1
9.	Differentiate between pin joint and rigid joint	Understanding & remembering	1
10.	Differentiate between method of joints and method of sections?	Understanding & remembering	1

LONG ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Outcome
1	Identify the forces in the members of the truss shown in figure. The cross sectional area of vertical and horizontal members is 4000 mm² and that of the diagonals is 6000mm² 	Analyze & Apply	1

2	Analyze the truss shown in figure by consistent deformation method. Assume that the cross-sectional areas of all members are same. 	Analyze & Apply	1
3	From the truss in Fig. T-01, determine the force in members BC, CE, and EF.  Figure T-01	Analyze & Apply	1
4	The roof truss shown in Fig. T-03 is pinned at point A, and supported by a roller at point H. Determine the force in member DG.  Figure T-03	Analyze & Apply	1
5	Determine the force in members AB, BD, and CD of the truss shown in Fig. P-414. Also solve for the force on members FH, DF, and DG.  Figure P-414	Analyze & Apply	1

6	Find the force acting in all members of the truss shown in Figure T-01.  Figure T-01	Analyze & Apply	1
7	The structure in Fig. T-02 is a truss which is pinned to the floor at point A, and supported by a roller at point D. Determine the force to all members of the truss.  Figure T-02	Analyze & Apply	1
8	Compute the force in all members of the truss shown in Fig. T-08.  Figure T-08	Analyze & Apply	1
9	Determine the force in members AB, BD, and CD of the truss shown in Fig. P-414. Also solve for the force on members FH, DF, and DG.  Figure P-414	Analyze & Apply	1

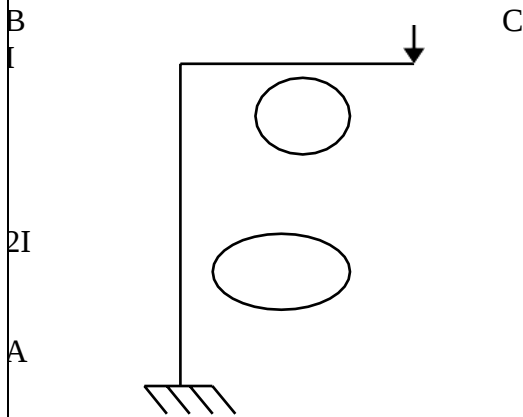
10	Determine the forces in the truss using method of section 	Analyze & Apply	1
----	--	-----------------	---

UNIT – II

SHORT ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Out come
1	Explain Strain Energy Method?	understanding	2
2	Explain Castigliano's Method?	understanding	2
3	What is an arch? Explain	understanding	2
4	Distinguish between two hinged and three hinged arches?	understanding	2
5	Give the equation for a parabolic arch whose springing is at different levels?	Understanding	2
6	Explain the effect of temperature on the horizontal thrust of a two hinged arch subjected to a system of vertical loads?	understanding	2
7	Indicate the positions of a moving point load for maximum negative and positive bending moments in a three hinged arch.	Remembering	2
8	Write down the expressions for radial shear and normal thrust in a three hinged parabolic arch?	Understanding	2
9	Define radial shear and normal thrust?	Understanding	2
10	Mention the examples where arch action is usually encountered?	Understanding	2

LONG ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Outcome
1	Determine the deflection of the free end of a cantilever of length L subjected to a concentrated load P at the free end.	Analyze & Apply	2
2	A simply supported beam of varying depth is loaded with a point load at 4m distance from support A is 60 kN. Determine the deflection under point load. Given: Moment of Inertia up to 4m from A is I and from 4m to 8m is $2I$. Assume E is constant.	Analyze & Apply	2
3	Determine the vertical deflection of point C in the frame show in fig. below. Determine the vertical deflection at free end of a overhanging beam 	Analyze & Apply	2
4	A three-hinged circular arch hinged at the springing and crown points has a span of 40 m and a central rise of 8 m. It carries a UDL of 20 kN/m over the left-half of the span together with a concentrated load of 100 kN at the right quarter span. Find Reactions at the supports Normal Thrust Shear at a section from 10m from left support	Analyze & Apply	2
5	A three-hinged circular arch hinged at the springing and crown points has a span of 25 m and a central rise of 5 m. It carries a Point load of 100 kN at 6 m from left support. Calculate	Analyze & Apply	2



6	Reactions at the supports Reactions at Crown Moment at 5 m from the left support	Analyze & Apply	2
7	A three-hinged semi-circular arch of radius 'R' carries UDL of w/unit length over its entire horizontal span. Determine Reactions at the supports Maximum Bending Moment in the arch	Analyze & Apply	2
8	A symmetric three-hinged parabolic arch has a span of 36 m and a central rise of 6 m is subjected to a concentrated load of 120 kN at a point from left support. Draw Bending Moment Diagram	Analyze & Apply	2
9	A symmetric three-hinged parabolic arch has a span of 60 m and a central rise of 12 m is subjected to a concentrated load of 40 kN acting at 10 m from its left support and UDL of 10 kN/m acting over its entire right-half span. Draw Bending moment Diagram for the arch.	Analyze & Apply	2
10	A three-hinged parabolic arch having supports at different levels i.e., support B is higher than 2 m support A, has a span of 40 m and a central rise of 5 m with reference to support A is subjected to an UDL of 30 kN/m acting over its entire left-half span. Determine Horizontal Thrust developed Bending Moment, Normal Thrust and Radial Shear Force developed at a section of 15 m from the left support Show that the parabolic shape is a funicular shape for a three-hinged arch subjected to a uniformly distributed load over to its entire span	Analyze & Apply	2

UNIT – III

SHORT ANSWER QUESTIONS.

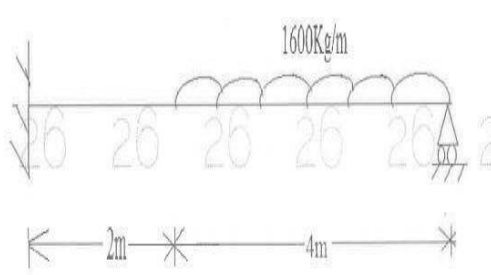
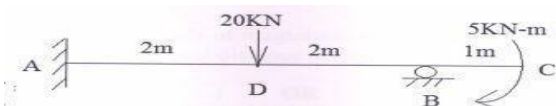
S.No	Question	Blooms Taxonomy Level	Program Outcome
1	What is a Prop?	Understanding	3
2	How to analysis Propped Cantilever and Fixed beams?	Understanding	3
3 3	What are the methods to calculate analysis of Propped Cantilever and Fixed beams?	Understanding	3
4	Give the relation between number of joints, number of members, in a perfect frame in plane and space structures	Understanding	3

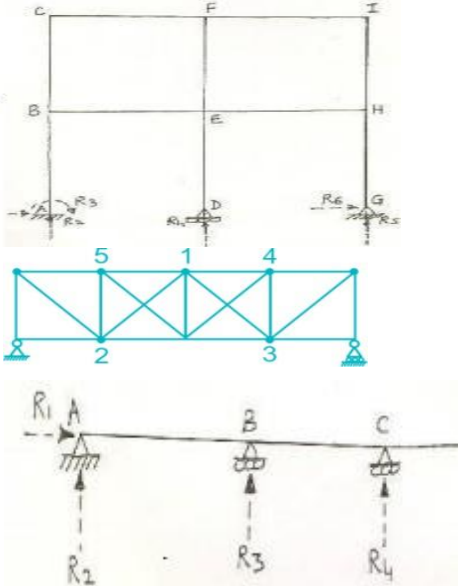


5	Explain the types of structures	Understanding	3 3
6	Explain the different types of props with the sketches	Understanding	3
7	In a member AB if a moment of 10kN-m is applied at A what's the moment carried over to the fixed support B.	Understanding	3 3
8	How fixed beam can be made statically determinate?	Understanding	3
9	What is hinge? How reactions will be calculated?	Understanding	3 3
10	How hinged beam can be made statically determinate?	Understanding	3

LONG ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Outcome
1	A fixed beam of length 3m is subjected to two point loads 9KN at the middle third point. Calculate Bending moment at the fixed end	Analyze & Apply	3 3
2	Calculate deflection at mid span for a propped cantilever beam of load 10Kn/m for a span of 4m	Analyze	3
3	Calculate maximum bending moment for a propped cantilever beam which carries a udl of 10Kn/m for a span of 2m.	Analyze	3 3
4	Calculate point of contra flexure for propped cantilever beam has a 4m length carries point load of 20KN at free end	Analyze & Apply	3

5	A cantilever of length 8m carries udl of 2Kn/m run over the whole length. The cantilever is propped rigidly at the free end. If $E=10^5 \text{N/mm}^2$ and $I=10^8 \text{ mm}^4$, then determine reaction at the rigid prop and deflection at the center	Analyze & Apply	3 3
6	Analyse the propped cantilever, during the loading the fixed end support is rotated by 0.002 radians in anticlockwise direction. Draw BMD 	Analyze & Apply	3
7	A fixed beam AB of length 6m carries a uniformly distributed load 3kn/m over the left half of the span together with a point load of 4kn at a distance of 4.5m from the left end. Determine the fixing end moments and support reactions.	Analyze & Apply	3 3
8	Determine the reactions of propped cantilever beam shown and draw BMD 	Analyze & Apply	3
9	A cantilever of length 8m carries udl of 10Kn/m run over the whole length. The cantilever is propped rigidly at the free end. If $E=20 \times 10^5 \text{N/mm}^2$ and $I=10^8 \text{ mm}^4$, then determine reaction at the rigid prop and deflection at the center.	Analyze & Apply	3 3

10	Find the static and kinematic indeterminacies of the below 	Analyze & Apply	3
----	---	-----------------	---

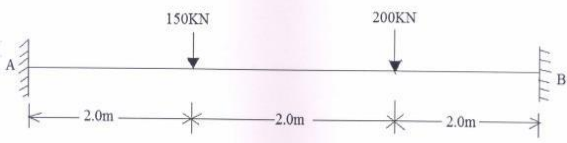
UNIT – IV

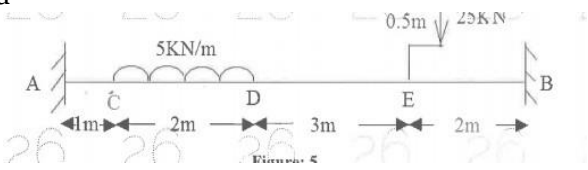
SHORT ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Out come
1	List out Assumptions made in Slope Deflection Method of analyzing Indeterminate structures	understanding	4
2	Explain Slope Deflection Equations	understanding	4
3	State relative merit of moment distribution method over slope deflection method.	remembering	4
4	Name the three classical force methods used in the analysis of continuous beams	remembering	4
5	What are the limitations of slope deflection method?	understanding	4
6	Write down the equilibrium equations used in slope deflection methods?	remembering	4
7	Why is slope deflection equation method known as stiffness method?	understanding	4

8	How to Analyse of Continuous beams with one end is fixed and other end is simply supported.	Analyze & Apply	4
9	How to Analyse of Continuous beams with both ends are supports simply supported.	Analyze & Apply	4
10	Analysis of Continuous beams with overhang at one end.	Analyze & Apply	4

LONG ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Outcome
1	Analyse the two span continuous beams and draw BMD, SFD, and Elastic Curve. Assume E is constant. AB = 4m, BC = 6m, UDL over span BC is 20 kN/m, Central Point Load on Span AB is 40 KN, Moment of Inertia of beam AB is I and BC is 2I	Analyze & Apply	4
2	Analyse the two span continuous beams and draw BMD, SFD, and Elastic Curve. Given: EI = 4000 kN-m ² , AB = 8m, BC = 4m, UDL over span AB is 20 kN/m, Central Point Load on Span BC is 60 kN. Both ends A and C are fixed. EI for span AB is 2 times of span BC.	Analyze & Apply	4
3 3	For the beam shown below If the left support and right support sinks by 15mm and 7mm respectively find moments and reactions at supports Draw BMD EI=6000Kn-m ² 	Analyze & Apply	4
4	Analyse the two span continuous beams and draw BMD, SFD, and Elastic Curve. Assume E and I is constant. AB = 6m, BC = 6m, UDL over span BC is 30 kN/m, Central Point Load on Span AB is 40 KN, Support A is fixed and C is simply supported.	Analyze & Apply	4

5	Analyse the two span continuous beams with overhang and draw BMD, SFD, and Elastic Curve. Assume E is constant. $AB = 6\text{m}$, $BC = 4\text{m}$, $CD = 2\text{m}$. UDL over span AB is 20 kN/m , Central Point Load on span BC is 80 kN and Point Load of 40 kN is acting at D . Beam CD is overhanging beam	Analyze & Apply	4
6	Analyse the three span continuous beams and draw BMD, SFD, and Elastic Curve. Given: $AB = 4\text{m}$, $BC = 4\text{m}$, $CD = 6\text{m}$. UDL over span AB is 30 kN/m , Central Point Load on span BC is 60 kN , and a Point load of 60 kN is acting at a distance of 2m from support B . Support A is Fixed and D is simply supported. Moment of Inertia: $AB = BC = I$, $CD = 2I$	Analyze & Apply	4
7	Find fixed end moments and reactions and draw BMD for the beam shown below assume necessary data 	Analyze & Apply	4
8	Analyse the three span continuous beams if support C sinks by 10mm and draw BMD, SFD, and Elastic Curve. Given: $AB = 3\text{m}$, $BC = 6\text{m}$, $CD = 3\text{m}$. UDL over span AB is 40 kN/m , a Point load of 120 kN is acting at a distance of 2m from support B , an UDL of 60 kN/m is acting over span CD . Both ends A and D are fixed. Moment of Inertia: $AB = CD = I$, $BC = 2I$. $E = 2 \times 10^5/\text{mm}^2$, $I = 4 \times 10^7\text{ mm}^4$.	Analyze & Apply	4
9	What are the advantages of slope-deflection method over moment distribution method?	Remembering & Understanding	4
10	Define distribution factor and carry over factor in moment distribution method.	Remembering & Understanding	4



UNIT – V
SHORT ANSWER QUESTIONS.

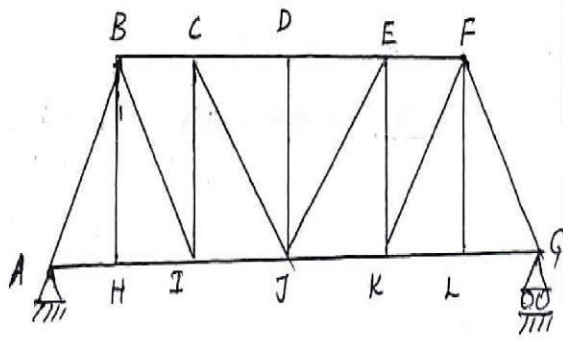
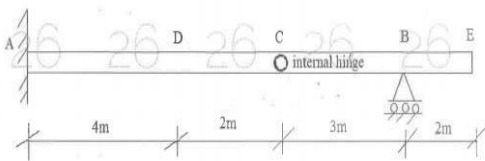
S.No	Question	Blooms Taxonomy Level	Program Out come
1	What is meant by ILD?	Understanding	5
2	What are the uses of influence line diagrams?	Remembering	5
3	State Muller Breslau's principle.	Remembering & Understanding	5
4	In the context of rolling loads, what do you understand by the term equivalent uniformly distributed load?	Remembering & Understanding	5
5	What is Influence line Diagrams for Simply Supported Beams	Understanding	5
6	What is Influence line Diagrams for Cantilever Beams?	Understanding	5
7	What is Influence line Diagrams for Overhang Beams?	Understanding & remembering	5
8	What is Influence line Diagrams for Double Overhang Beams?	Understanding	5
9	When a series of wheel loads move along a girder, what is the condition for getting	Remembering & Understanding	5
10	What is Maximum bending moment under any one point load?	Understanding	5

LONG ANSWER QUESTIONS.

S.No	Question	Blooms Taxonomy Level	Program Out come
1	A single rolling load of 100 kN moves on a girder of span 20m. Construct the influence lines for (i) Shear force and (ii) Bending moment for a section 5m from the left support.	Analyze & Apply	5
2	Determine the influence line diagram for bending moment at a point D, the middle point of span AB of a continuous beam ABC of span AB=6m and BC=4m simply supported at supports A,B and C. Compute the ordinates at every 1m interval.	Analyze & Apply	5
3	Construct the influence lines for points at which the maximum shears and maximum bending moment develop. Determine these maximum values.	Analyze & Apply	5



4	Derive the influence diagram for reactions and bending moment at any section of a simply supported beam. Using the ILD, determine the support reactions and find bending moment at 2m, 4m and 6m for a simply supported beam of span 8m subjected to three point loads of 10kN, 15kN and 5kN placed at 1m, 4.5m and 6.5m respectively.	Analyze & Apply	5
5	A simply supported beam has a span of 15 m. an UDL of 40 kN/m and 5 m long crosses the girder from left to right. Draw ILD for SF and BM at a section 6m from left end. Use these diagrams to calculate the maximum shear force and bending moment at this section.	Apply	5
6	Find Maximum SF & BM, and Absolute Maximum SF & BM values due to Moving Loads Single Point Load	Analyze &	5
7	A) What is an influence line? B) Draw the influence lines for various members of a Pratt Truss with parallel chords	Understand & Practice	5
8	The warren girder of 25m span is made of 5 panels of 5m each. The diagonals are inclined at 60° to the horizontal. Draw the influence line diagram for force in upper chord member in the second panel from left. Hence evaluate the forces in it when there is load of 60 kN at each lower joint.	Analyze & Apply	5
9	Two point loads of 100kN and 200kN spaced 3m apart cross a girder of span 12 meters from left to right with the 100kN leading. a. Draw the ILD for shear force and bending moment and find the values of maximum bending moment b. Find the values of maximum shear force and bending moment at a section 4m from the left hand support. 3. Evaluate the absolute maximum bending moment due to the given loading system.	Analyze & Apply	5

10	Analysis the IL for force in member BC and CI for the truss shown in figure. The height of the truss is 9m and each segment is 9m long.  1. Determine the maximum shear forces and bending moment diagram 2. Calculate values at 5m and 8m from the left hand support. 3. Draw ILD for a) reaction V_b at B b) reaction V_a at A c) Shear force at D d) BM at D find max values of these at LL of 20kN-m 	5 Analyze & Apply
-----------	--	-------------------------------------



XI. OBJECTIVE QUESTIONS: JNTUH

UNIT – I

1. Castigliano's theorem is applied to
 - a. Simply supported beam
 - b. Propped cantilever beam
 - c. Fixed & continuous beam
 - d. Continuous beam only
2. For a symmetrical two hinged parabolic arch, if one of the supports settles horizontally, then the horizontal thrust
 - a) is increased
 - b) is decreased
 - c) remains unchanged
 - d) becomes zero
3. The Castigliano's second theorem can be used to compute deflections
 - a. in statically determinate structures only
 - b. for any type of structure
 - c. at the point under the load only
 - d. for beams and frames only
4. The elastic strain energy stored in a rectangular cantilever beam of length L subjected to a bending moment M applied at the end is
 - a. $ML^2/2EI$
 - b. $M^2L/2EI$
 - c. $M^2L/3EI$
 - d. $M^2L/16EI$
5. In case of a trussed beam the strain energy stored is due to
 - a. Bending only
 - b. direct force only
 - c. Both bending and direct force
 - d. none
6. A beam carries a uniformly distributed load throughout its length. In which of the following configurations will strain energy be maximum
 - a. Cantilever
 - b. simply supported beam
 - c. Propped cantilever.
 - d. fixed beam.
7. Unit Load method is based on []
 - a) Internal strain energy
 - b) Theorem of minimum potential energy
 - c) Castigliano's theorem
 - d) Betti's theorem
8. Strain energy is a form of []
 - a) kinetic energy
 - b) Heat energy
 - c) Potential energy
 - d) Plastic energy
9. Arches are of geometrical shapes of []
 - a) Rectangular
 - b) Square
 - c) Triangular
 - d) Circular
10. Loads which are not considered in the analysis of arches are []
 - a) Externally applied loads
 - b) Support settlements
11. Deflection at mid span of a fixed beam subjected to UDL []
 - a) $5/384 * wl^4/EI$
 - b) $1/384 * wl^4/EI$
 - c) $1/192 * wl^4/EI$
 - d) $1/84 * wl^4/EI$
12. Castigliano's second theorem is.....
13. Expression for strain energy due to bending is given by...
14. Betti's theorem states that....
15. The economy of a particular Arch is influenced by.....



UNIT – II

1. The number of simultaneous equations to be solved in the slope deflection method, is equal to
 - a) The degree of statically indeterminacy
 - b) The degree of kinematic indeterminacy
 - c) The number of joints in the structure
 - d) None of the above
2. The analysis of a statically indeterminate beam can be done by
 - a) Equations of static equilibrium alone
 - b) Equations of displacement or deformations
 - c) both a&b
 - d) none of the above
3. A prismatic beam of length L is simply supported at a total u.d.l. of W spread over its entire span. It is then propped at its centre to neutralize the deflection. The net bending moment at its centre will be
 - a. WL
 - b. $WL/8$
 - c. $WL/24$
 - d. $WL/32$
4. A propped cantilever of span ' L ' is subjected to a moment $+M$ (sagging) at the propped end. The moment at the fixed end will be
 - a. M (hogging)
 - b. $2M$ (hogging)
 - c. $M/2$ (hogging)
 - d. none
5. The ratio of maximum deflections of a Simply supported beam and fixed beam carrying U.d.l. throughout is
 - a. 2
 - b. 3
 - c. 4
 - d. 5
6. A fixed beam of span 4 metres is subjected to a u.d.l. of 30 kN/m . The support moment in kN.m
 - a. 40
 - b. 60
 - c. 30
 - d. 120
7. The prop reaction of a propped beam with central load ' W ' is []
 - a) $7/8 W$
 - b) $5/8 W$
 - c) $3/10 W$
 - d) $5/16 W$
8. The moment at fixed end in a propped beam due to a couple M_0 applied at prop end is []
 - a) $M_0/2$
 - b) $M_0/4$
 - c) $M_0/6$
 - d) $M_0/8$
9. when the left support of a fixed beam rotates by ' θ ', the fixed end moment at right support is
 - a) $2EI\theta/L$
 - b) $4EI\theta/L$
 - c) $6EI\theta/L$
 - d) $12EI\theta/L$
10. Static Indeterminacy of a propped beam is
11. The prop reaction of a propped beam carrying udl ' w ' is.....
12. The static indeterminacy of a Fixed beam with vertical loading only is.....
13. A beam restrained from both rotation and translation at one and free at the other support is called
14. For which one of the following cases is the Muller-Breslau principle applicable to get influence line?
 - (a) Reaction at the ends of a simple beam
 - (b) Bending moment at a section
 - (c) Shear force at a section
 - (d) Forces and moments at any section



15. In an axially loaded spirally reinforced short column, the concrete inside the core is subjected to
- a. bending and compression
 - b. biaxial compression
 - c. triaxial compression
 - d. uniaxial compression

UNIT – III

1. The number of members required for perfect frame _____
(a) $m = 2 - 3j$ (b) $m = 3j - 1$ (c) $m = 2j - 3$ (d) $m = 2i + 1$
2. What are equations of equilibrium?
(a) Summation of all the moments (b) moments in X direction
(c) Moments in Y direction (d) moments in Z direction.
3. Number of unknown internal forces in each member of a rigid jointed plane frame is
a) 1 b) 2 c) 3 d) 6
4. A rigid-jointed plane frame is stable and statically determinate if
a) $(m + r) = 2j$ b) $(m + r) = 3j$
c) $(3m + r) = 3j$ d) $(m + 3r) = 3j$
5. If in a rigid-jointed space frame, $(6m + r) < 6j$, then the frame is
a) Unstable b) stable and statically determinate
c) Stable and statically indeterminate e) none of the above
6. If there are m unknown member forces, r unknown reaction components and j number of joints, then the degree of static indeterminacy of a pin-jointed plane frame is given by
a) $m + r + 2j$ b) $m - r + 2j$ c) $m + r - 2j$ d) $m + r - 3j$
7. A pin-jointed plane frame is unstable if
a) $(m + r) < 2j$ b) $m + r = 2j$ c) $(m + r) > 2j$ d) $(m + r) > 2j$
8. Truss member are connected at joints by []
a) Bolts b) Links c) Rollers d) Springs
9. A force in a member of a truss can be a []
a) Moment b) Tension c) Shear d) Twisting moment
10. A truss can be unstable even when it is.....
11. The degree of indeterminacy of a truss is given by the expression.....
12. Which of the following terms represents the torque corresponding to a twist of one radian in a shaft over its unit length?
(a) Torsional stress (b) Torsional rigidity
(c) Flexural rigidity (d) Moment of resistance
13. A rectangular beam of width 100 mm is subjected to a maximum shear force of 60 kN. The corresponding maximum shear stress in the cross-section is 4 N/mm^2 . The depth of the beam should be
(a) 200 mm (b) 150 mm (c) 100 mm (d) 225 mm



14. Out of the two beams of the same material and same cross-sectional area, one is of circular cross-section and the other is of square cross-section. If each of these is subjected to bending moment of the same magnitude, then
 - (a) both sections would be equally strong.
 - (b) both sections would be equally economical
 - (c) square section would be more economical than circular section
 - (d) square section would be less economical than circular section
15. For the design of a cast iron member, the most appropriate theory of failure is
 - (a) Mohr's theory
 - (b) Rankine's theory
 - (c) maximum stress theory
 - (d) maximum shear energy theory

UNIT – IV

1. The slope deflections equations give the relationship between
 - a. slope and deflection only
 - b. Bending moment and rotation only
 - c. B.M. and vertical deflection only
 - d. Bending moment rotation and deflections
2. In slope deflection method the displacements considered are due to
 - a. shear force
 - b. Bending moment
 - c. Axial force and bending moment
 - d. Shear force and bending moment
3. The no. Of simultaneous equations to be solved in the slope deflection method is equal to
 - a. static indeterminacy
 - b. Kinematic indeterminacy
 - c. No. of joint displacements in the structure
 - d. None of the above.
4. The ratio of stiffness of a beam at a joints with onside hinged support and other side fixed is (Assuming both beams have same I and L)
 - a.1/2
 - b.3/4
 - c.1
 - d.4/3
5. The reaction at the middle support is
 - a. WL
 - b.5wL/2
 - c.5wL/4
 - d.5wL/8
6. The bending moment at the middle support is
 - a.Wl²/4
 - b. Wl²/8
 - c.Wl²/12
 - d. Wl²/16
7. Moment distribution method is proposed by []
 - A) Hardy cross
 - B) Muller
 - C) Hooke
 - D) None
8. The method used for analysis of indeterminate beams and rigidly jointed frames []
 - A) Moment area method
 - B) Shear force
 - C) Slope deflection method
 - D) None
9. In slope deflection method, the deformations are considered to be caused by []
 - A) BM
 - B) Shear force
 - C) Axial force
 - D) All
10. The slope deflection equations give the relationship between []
 - A) Slope and deflection only
 - B) BM and rotation only
 - C) BM and Shear force
 - D) BM, rotation and deflection
11. The number of simultaneous equations to be solved in slope deflection method is equal to
 - A) Static indeterminacy
 - B) Kinematic indeterminacy
 - C) Both
 - D) None



12. The three moments equation is applicable only when
a. the beam is prismatic b. there is no settlement of supports
c. there is no discontinuity such as hinges within the span d. the spans are equal
13. The number of independent displacement components at each joint of a rigid-jointed space frame is
a. 1 b. 2 c. 3 d. 6
14. The Muller-Breslau principle in structural analysis is used for
(a) drawing influence line diagram for any force function
(b) superimposition of load effects
(c) writing virtual work equation (d) None of the above
15. If a shaft rotates at 100 r.p.m. and is subjected to a torque of 3000 N-m, the power transmitted in kW would be
(a) 30 (b) 15 (c) 20 (d) 10

UNIT-V

1. What is /are the use(s) of influence lines?
a. to study the effect of moving loads on the structure
b. To calculate the value of stress function with the critical load condition
c. To find the position of live load for a maximum value of particular stress function
d. Towards all the above purpose
2. Which one of the following is correct in respect of the influence line for the bending moment at one fourths of the span from left support of a prismatic beam simply supported at ends?
a. It is composed of straight lines only b. It is composed of curved lines only
c. It is composed of straight and curved lines d. It is parabolic.
3. What is the shape of influenced line diagram for the maximum B.M in respect of a simply supported beam?
a. Rectangular b. triangular c. parabolic d. circular
4. What is the variation of influenced line for stress function in a statically determinate structure?
a. Parabolic b. Bilinear c. linear d. Uniformly Rectangular.
5. Muller-Breslau Principle is applicable to get influence line for which one of the following?
a. reaction at the ends of simple beam b. Bending moment at a section
c. Shear force at a section d. Force and moments at any section



6. For a simply supported beam of span 10M, I.L.D is drawn for B.M. at a section 4m from the left hand support. The maximum B.M. at the section due to a moving point load of 160KN, is equal to
a. 640kN.m b. 960kN.m. c. 384kN.m. d. 400kN.m
7. For any parameter at a section is a diagram showing the variation in the parameter at that sections a unit load rolls over the span. []
a) BMD b) Influence line c) Shear force d) None
8. To draw influence lines for any linear system, principle used []
a) Adward's b) Hoen's c) Muller's d) None
9. The relative stiffness of a propped cantilever of length L is []
a) $34L$ b) $3/L$ c) $2/3L$ d) None
10. Cause for side sway of frame is []
a) Settlement of supports b) horizontal loading
c) unsymmetrical loading d) all the above
11. If the shear force at the section of the beam under bending is equal to zero , then the bending moment at the section is []
a) Zero b) Max c) Minimum d) None
12. Which of the following is/are determined at a point of a given beam by moment areamethod?
1. Shear force 2. Bending moment 3. slope 4. deflection
Select the correct answer using the codes given below:
a. 1 and 2 b. 3 alone c. 4 alone d. 3 and 4
13. Which one of the following rules ascertains the maximum permissible eccentricity of loads ncircular column so that stresses will always be compressive?
a. Middle fourth rule b. Middle third rule c. Middle half rule d. Middle two-third rule
14. In moment distribution method, the sum of distribution factors of all the members meetingat any joint is always
a. zero b. less than 1 c. 1 d. greater than 1
15. Principle of superposition is applicable when deflections are linear functions of appliedforces
a. material obeys Hooke's law
b. the action of applied forces will be affected by small deformations of the structure
c. both a and b d. none of the above



GATE QUESTIONS:

1. A pin-jointed plane frame is unstable if
 - a. $(m + r) < 2j$
 - b. $m + r = 2j$
 - c. $(m + r) > 2j$
 - d. none of the above
2. The degree of static indeterminacy of a rigid-jointed space frame is
 - a. $m + r - 2j$
 - b. $m + r - 3j$
 - c. $3m + r - 3j$
 - d. $6m + r - 6j$
3. If there are m unknown member forces, r unknown reaction components and j number joints, then the degree of static indeterminacy of a pin-jointed plane frame is given by
 - a. $m + r + 2j$
 - b. $m - r + 2j$
 - c. $m + r - 2j$
 - d. $m + r - 3j$
4. The number of independent equations to be satisfied for static equilibrium in a space structure is
 - a. 2
 - b. 3
 - c. 4
 - d. 6
5. If in a rigid-jointed space frame, $(6m + r) < 6j$, then the frame is
 - a. unstable
 - b. stable and statically determinate
 - c. stable and statically indeterminate
 - d. none of the above
6. In the slope deflection equations, the deformations are considered to be caused by i) bending moment ii) shear force iii) axial force The correct answer is
 - a. only (i)
 - b. (i) and (ii)
 - c. (ii) and (iii)
 - d. (i), (ii) and (iii)
7. Castigliano's first theorem is applicable for statically determinate structures only when
 - a. the system behaves elastically
 - b. principle of superposition is valid
 - c. none of the above
 - d. both a and b
8. Number of unknown internal forces in each member of a rigid jointed plane frame is
 - a. 1
 - b. 2
 - c. 3
 - d. 6
9. A rigid-jointed plane frame is stable and statically determinate if
 - a. $(m + r) = 2j$
 - b. $(m + r) = 3j$
 - c. $(3m + r) = 3j$
 - d. $(m + 3r) = 3j$
10. The deflection at any point of a perfect frame can be obtained by applying a unit load at the joint in
 - a. vertical direction
 - b. horizontal direction
 - c. inclined direction
 - d. direction in which the deflection is required
11. If in a pin-jointed plane frame $(m + r) > 2j$, then the frame is
 - a. stable and statically determinate
 - b. stable and statically indeterminate
 - c. unstable
 - d. none of the above
12. Independent displacement components at each joint of a rigid-jointed plane frame are
 - a. three linear movements
 - b. two linear movements and one rotation
 - c. one linear movement and two rotations
 - d. three rotations
13. The degree of static indeterminacy of a pin-jointed space frame is given by
 - a. $m + r - 2j$
 - b. $m + r - 3j$
 - c. $3m + r - 3j$
 - d. $m + r + 3j$
14. In column analogy method, the area of an analogous column for a fixed beam of span L and flexural rigidity EI is taken as
 - a. L/EI
 - b. $L/2EI$
 - c. $L/3EI$
 - d. $L/4EI$



15. Degree of kinematic indeterminacy of a pin-jointed plane frame is given by
a. $2j - r$ b. $j - 2r$ c. $3j - r$ d. $2j + r$
16. The carryover factor in a prismatic member whose far end is fixed is
a. 0 b. $\frac{1}{2}$ c. $\frac{3}{4}$ d. 1
17. The degree of kinematic indeterminacy of a pin-jointed space frame is
a. $2j - r$ b. $3j - r$ c. $j - 2r$ d. $j - 3r$
18. The degree of static indeterminacy up to which column analogy method can be used is
a. 2 b. 3 c. 4 d. unrestricted
19. Degree of static indeterminacy of a rigid-jointed plane frame having 15 members, 3 reaction components and 14 joints is
a. 2 b. 3 c. 6 d. 8
20. The principle of virtual work can be applied to elastic system by considering the virtual work of
a. internal forces only b. external forces only
c. internal as well as external forces d. none of the above

IES QUESTIONS:

- 1) Consider the following parameters with regards to slenderness ratio of a compression member:
1). Material 2). Sectional configuration
3). Length of member 4). Support end conditions
2. On which of these parameters does the slenderness ratio of a compression member depend?
(a) 1,2 and 3 only (b) 1,3 and 4 only (c) 2,3 and 4 only (d) 1,2,3 and 4
3. Two equal angles, each being ISA 100 mm $\times$ 100 mm of thickness 10 mm, are placed back-to-back and connected to either side of a gusset plate through a single row of 16 mm diameter rivets in double shear. The effective areas of the connected and unconnected legs of each of these angles are 775 mm² and 950 mm² respectively. If these angles are not tack-riveted, the net effective area of this pair of angles is
(a) 3650 mm² (b) 3450 mm² (c) 3076 mm² (d) 2899 mm
4. A bar AB of diameter 40 mm and 4 m long is rigidly fixed at its ends. A torque 600 N-m is applied at a section of the bar, 1 m from end A. The fixing couples T_A and T_B at the supports A and B, respectively are
(a) 200 N-m and 400 N-m (b) 300 N-m and 150 N-m
(c) 450 N-m and 150 N-m (d) 300 N-m and 100 N-m



5. Consider the following statements for longitudinal reinforcement in a RC member to resist earthquake force:

1. The tension steel ratio on any section shall not be less than $\frac{f_y}{f_{ck}} \geq 0.24$
2. There shall be two bars at top as well as bottom of the member throughout.
3. The 'positive' steel at a joint face must be at least equal to half the 'negative' steel at that face.

Which of these statements are correct?

- (a) 1 and 2 only (b) 1 and 3 only (c) 2 and 3 only (d) 1, 2 and 3

6. The maximum number of unknown forces that can be determined in a concurrent coplanar force system under equilibrium is

- (a) 2 (b) 3 (c) 6 (d) 1

7. The maximum bending moment under a particular point load among a train of point loads crossing a simply supported girder occurs when that load is

- (a) at mid-span (b) at one-third span (c) at one-quarter span
(d) so placed that the load point and the point of CG of the train of loads are equidistant from the mid-span

8. uniformly distributed load of length 8 m crosses a simply supported girder of span 20 m. The maximum bending moment at the left quarter-span point occurs when the distance between the point of CG of the total load and mid-span is

- (a) 0 (b) 2 m (c) 3 m (d) 4 m

9. Consider the following statements:

1. The principle of superposition will hold good for the analysis of linear structural systems only
2. The stress in a structural member due to several applied forces is the sum of the effects due to each of such forces, applied one at a time, only if the Hooke's law hold good.
3. Internal stresses may not be caused resulting from lack of fit of a structural member.

Which of these statements are correct?

- (a) 1, 2 and 3 (b) 1 and 2 only (c) 2 and 3 only (d) 1 and 3 only

10. Consider the following statements:

1. A properly constrained rigid system has several degrees of freedom.
2. The number of degrees of freedom of a locomotive moving on a railway track is only two.
3. A floating ship has six degrees of freedom.

Which of these statements is/are correct?

- (a) 1, 2 and 3 (b) 3 only (c) 2 only (d) 1 only

11. suspension bridge with a two-hinged stiffening girder is statically

- (a) determinate (b) indeterminate to 1 degree
(c) indeterminate to 2 degrees (d) indeterminate to 3 degrees



XIII. WEBSITES:

- a. <http://www.asce.org>
- b. <http://www.icivilengineer.com>
- c. <http://www.construction-guide.in>

XIV. EXPERT DETAILS:

- a. Prof. SATISH C. SHARMA Department of Mechanical & Industrial Engineering Indian Institute of Technology Roorkee
- b. Prof. M.S. Sivakumar Department of Applied Mechanics, IIT Madras.
email: mssiva@iitm.ac.in
- c. Prof. S.K. Bhattacharyya, Department of Civil Engineering, IIT Kharagpur.
- d. Dr. Satish C Sharma (IITR)
- e. LS Ramachandra & SK Barai (IITKGP)

XV. JOURNALS:

0970-1141	Thesis Digest on civil Engineering	1987
0973-8061	International Engineering and Technology Journal of Civil and Structure	2007
0975-5314	International journal of civil engineering	2009
0975-6744	Journal of information knowledge and research in civil engineering	2009
0976-6308	International journal of civil engineering and technology	2010
2249-426X	International Journal of Civil Engineering and Applications	2011
2249-8753	Recent Trends in Civil Engineering and Technology	2011
2277-5986	World Research Journal of Civil Engineering	2011
2277-7032	International Journal of Structural and Civil Engineering	2012
2278-9987	International Journal of Civil Engineering (IJCE)	2012
2319-6009	International Journal of Structural and Civil Engineering Research	2012
2320-723X	International Journal of Advanced Research in Civil, Structural, Environmental and Infrastructure Engineering and Developing	2013



XVI. LIST OF TOPICS FOR STUDENT SEMINARS:

- a. Analysis of Arches – Three Hinged and Two Hinged Arches
- b. Analysis of indeterminate structures using following methods
- c. Slope Deflection Method
- d. Moment Distribution Method
- e. Finding Deflections using Energy Theorems
- f. Simple Beams
- g. Pin-jointed Trusses

XVII. CASE STUDIES / SMALL PROJECTS:

- a. Case study on Analysis of Arches – Three Hinged and Two Hinged Arches
- b. Case study on Analysis of indeterminate structures using following methods
- c. Slope Deflection Method
- d. Moment Distribution Method
- e. Case study on Finding Deflections using Energy Theorems
- f. Simple Beams
- g. Pin-jointed Trusses
- h. Case study on Analysis of structures under Moving Loads with the help of Influence Lines
- i. Case study on Indeterminate Structural Analysis of Truss using Castigliano's theorem