Course File

Subject Title/Subject Code: Structure Analysis II
6CE4-02

Semester: VI Year: III

Name of the Faculty: Mrs. Prachi Singhal
E-mail id: prachi.singhal@technonjr.org

Class Schedule

Total Number of Lectures: 42

i) Course Objective

To develop proficiency in advanced structural analysis techniques, including deflection analysis, energy methods, influence line diagrams, and the study of arches and unsymmetrical bending, while applying approximate methods to analyze complex structural systems.

INDEX - COURSE FILE

S. No.	CONTENT / ITEM NO.	PAGE NO.	STATUS
1	Vision And Mission Of The Institute		
2	Vision And Mission Of The Department		
3	Program Educational Objective Of Department (PEO's)		
4	Program Outcomes Of Department (PO's)		
5	Course Outcome (COs)		
6	COs mapping with Pos and PSOs		
7	Academic Calendar		
8	Evaluation Scheme		
9	Course Syllabus		
10	Prescribed Books		
11	Copy Of Time Table		
12	Course Schedule Plan		
13	Assignment Sheet (Unit Wise)		
14	Quiz Questions (One From Each Unit)		
15	Question Papers Of Mid Term Exam-I		
16	Marks and Gap Analysis in Mid Term I		
17	Remedial Action Taken To Remove the Gaps after mid Term I		
18	Question Papers Of Mid Term Exam-II		
19	Gap Analysis in Mid Term II		
20	Remedial Action Taken To Remove the Gaps after mid Term II		
21	Model Question Paper With Key Solution		
22	University Question Paper (Last one year)		
23	Student Performance Report		
24	Result Analysis		

VISSION & MISSION OF INSTITUTE

Vision

Empowering student with recent and emerging technologies to create innovative technical leaders capable of contributing to industrial and societal needs for betterment of mankind across the globe.

Mission

M1: To provide dynamic learning environment to students by providing constant exposure to latest technologies by linking closely with the industries.

M2: To establish effective interface with industry to obtain live problems to enhance critical thinking and problem solving skills among students and consultancy projects for faculty.

M3: To provide avenues and opportunities to faculty for domain specific trainings and qualification upgradation.

M4: To develop ethical leaders with strong communication skills.

VISION & MISSION OF DEPARTMENT

Department Vision

To increase students learning of fundamentals for designing and planning of buildings and latest technologies through industry-aligned project-based learning which will help in transforming students to be good civil engineering professionals leading to innovation and incubation of new ideas.

Department Mission

M1: To create experimental learning through solving problems of Government, Society, Smart Cities, Industry and other entities.

M2: To teach the latest technologies to the students as beyond the syllabus activity so that they are updated and industry ready.

M3: To enable engineering students understand industry-aligned technologies and learn to find solutions from their early engineering days and this is the only way to produce globally relevant engineers solving real-life problems applying current technologies.

M4: To enable students to generate projects through problem faced by and requirement of Smart cities, industry, Government and other entities whereby those outlined problem statements are to be studied deeply by a group of faculty members to convert them into real-time project format.

PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

PEOs 1: To provide an in-depth understanding of the fundamentals of Civil Engineering and create a foundation for lifelong learning to facilitate a progressive career in the construction Industry, as an entrepreneur and in pursuit of higher studies.

PEOs 2: To equip the students with technical and analytical skills to develop innovative solutions to complex real-life problems using existing and novel technologies. To equip the students with good communication and interpersonal skills, inter-disciplinary teamwork and leadership skills to enable them to fulfill professional responsibilities.

PEOs 3: To expose them to various contemporary issues which will enable them to become ethical and responsible towards themselves, co-workers, Society and the Nation.

PEOs 4: To make the student's industry ready by imparting education related to the latest technologies so that they can grab future industry jobs.

PROGRAM SPECIFIC OUTCOMES (PSO's)

PSO1: To be aware of and initiate some-work on future technologies and new developments which may impact the future Industry 4.0.

PSO2: Hands on training on upcoming technologies and project-based learning.

PSO3: Get exposure to BIM (Building Information Modeling).

PROGRAMME OUTCOMES (POs)

A student will develop:

PO01. ENGINEERING KNOWLEDGE: An ability to apply knowledge of Mathematics, Science and Engineering Fundamentals in Electronics and Communication Engineering.

PO02. PROBLEM ANALYSIS: Ability to analyze and interpret data by designing and conducting experiments. Develop the knowledge of developing algorithms, designing, implementation and testing applications in electronics and communication related areas.

PO03. DESIGN/ DEVELOPMENT OF SOLUTION: An ability to Design a system Component or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.

PO04. CONDUCTION OF INVESTIGATION OF COMPLEX PROBLEMS: Ability to Identify, formulate and solve engineering problems.

PO05. MODERN TOOL USAGE: An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.

PO06. THE ENGINEERING AND SOCIETY: Broad education necessary to understand the impact of engineering solutions in a global, economic, environmental and societal context.

PO07. ENVIRONMENT & SUSTAINABILITY: Understand the impact of professional engineering solution in societal and environmental contexts, and demonstrate the knowledge of, and need of sustainable development.

PO08. ETHICS: An ability to understand the professional, social and ethical responsibility.

PO09. INDIVIDUAL AND TEAM WORK: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. COMMUNICATION: An ability to Communicate effectively in order to succeed in their profession such as, being able to write effective reports and design documentation, make effective presentations.

PO11. PROJECT MANAGEMENT & FINANCE: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in team, to manage projects and in multidisciplinary environment.

PO12. LIFE-LONG LEARNING: Recognize the need and an ability to engage in life-long learning.

COURSE OUTCOMES (COs) OF THE SUBJECT

CO No.	Mapping	Statement
CO35301.1	**Analyzing**	Students will be able to calculate deflections in determinate and indeterminate structures using the unit load method and energy methods.
CO35301.2	**Analyzing**	Students will be proficient in analyzing and interpreting influence line diagrams for beams and frames under various loading conditions.
CO35301.3	**Analyzing**	Students will understand the analysis of three-hinged, two-hinged, and fixed arches, including the calculation of horizontal thrusts.
CO35301.4	**Analyzing**	Students will be able to analyze the effects of unsymmetrical bending, including locating the neutral axis and calculating resulting stresses and deflections.
CO35301.5	**Applying**	Students will gain the ability to apply approximate methods like the portal and cantilever methods to analyze multistory frames under lateral loads.

COS MAPPING WITH POs AND PSOs

Course Outcome	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
CO1	2	2	2	2	0	0	1	0	0	0	0	1	1	1	1
CO2	2	2	2	2	0	0	0	0	0	0	0	0	1	1	1
CO3	1	2	2	1	0	0	2	0	0	0	0	1	1	1	1
CO4	3	3	3	3	0	0	1	0	0	0	0	1	2	2	2
CO5	2	2	2	2	0	0	1	0	0	0	0	1	2	2	2

UNIVERSITY ACADEMIC CALENDAR

Academic Calendar for even Semester for Session

Course: Bachelor of Technology (B.TECH.)				
Course: Bachelor of Technology (B.TECH.)				
Semester	II	IV	VI	VIII
Commencement of Classes	26.02.2024	15.02.2024	15.02.2024	02.01.2024
First Mid Term	02.04.2024	20.03.2024	20.03.2024	15.02.2024
Second Mid Term	03.06.2024	06.05.2024	06.05.2024	21.03.2024
Last Working Day	10.06.2024	31.05.2024	31.05.2024	20.04.2024
Commencement of Practical Exams	01.07.2024	03.06.2024	03.06.2024	22.04.2024
Commencement of Theory Exams	19.06.2024	14.06.2024	15.06.2024	02.05.2024
Project (VIII)	06.05.2024 to 15.05.2024			
Practical Training (After II Sem.)	15.07.2024 To 31.07.2024			
Practical Training (After IV Sem.)	01.07.2024 To 17.08.2024			
Practical Training (After VI Sem.)	01.07.2024 To 17.08.2024			
Commencement of Classes for next Odd Semesters (2023-24)	I	III	V	VII
	01.08.2024	01.08.2024	20.08.2024	20.08.2024

ACADEMIC CALENDAR OF INSTITUTE

Academic Calendar for even Semester for Session 2023-24 (Even Semester)

Course: Bachelor of Technology (B.TECH.)				
Semester	**II**	**IV**	**VI**	**VIII**
Commencement of Classes	26-02-2024	15-02-2024	15-02-2024	2-01-2024
Commencement of First Mid Term	20-04-2024	25-03-2024	25-03-2024	15-02-2024
Commencement of Second Mid Term	05-06-2024	24-05-2024	24-05-2024	21-03-2024
Last Working Day	15-06-2024	31-5-2024	31-5-2024	20-04-2024
Commencement of Practical Exams	01-07-2024	04-6-2024	03-6-2024	22-04-2024
Commencement of Theory Exams	19-6-2024	15-6-2024	14-6-2024	02-05-2024
Project (VIII)	06.05.2024 to 15.05.2024			
Practical Training (After II Sem.)	15.07.2024 To 31.07.2024			
Practical Training (After IV Sem.)	01.07.2024 To 17.08.2024			
Practical Training (After VI Sem.)	01.07.2024 To 17.08.2024			

Evaluation Scheme

FACULTY DETAILS:

Name of the Faculty : Prachi Singhal
Designation : Assistant Professor

Department : Civil Engineering

1. TARGET

a) Percentage Pass: 100%
b) Percentage I class: 60 %

2. METHOD OF EVALUATION

- ☐ Continuous Assessment Examinations (Mid-Term 1, Mid-Term 2)
- ☐ Assignments / Seminars
- ☐ Mini Projects
- ☐ Quiz
- ☐ Semester Examination

Others_____

3. List out any new topic(s) or any innovation you would like to introduce in teaching the subject in this Semester.
4. Take the help of creative tools to stimulate creativity. Include slide presentations, demonstration or forms of visual exercises that will excite the young minds and capture their interest.

Signature of Faculty: **Signature of HOD**

UNIVERSITY SYLLABUS

6CE4-02: STRUCTURAL ANALYSIS-II

Credit: 3 **Max. Marks: 150(IA:30, ETE:120)**
3L+0T+0P **End Term Exam: 3 Hours**

SN	CONTENTS	Hours
1	**Introduction:** Objective, scope and outcome of the course.	1
2	Unit load method & their applications: deflection of determinate beams and frames, analysis of determinate and redundant frames up to two degree of redundancy, lack of fit in redundant frames. Introduction to Energy Methods: Strain energy for gradually applied, suddenly applied and impact loads, Strain energy due to axial loads, bending, shear and torsion;. Castiglione's theorems & their applications in analysis of determinate and redundant frames up to two degree of redundancy and trussed beams; Stresses due to temperature & lack of fit in redundant frames; deflection of determinate beams, frames using energy methods	12
3	**Influence line diagram & Rolling load:** ILD for beams & frames, Muller-Breslau principle and its application for drawing ILD, Rolling load, maximum stress resultants in a member/section, absolute maximum stress resultant in a structure.	10
4	**Arches:** analysis of three hinged two hinged and fixed type parabolic arches with supports at the same level and at different levels.	7
5	**Unsymmetrical bending:** Definition, location of NA, computation of stresses and deflection, shear centre and its location,	6
6	**Approximate methods for lateral loads:** Analysis of multistory frames by portal method, cantilever method & factor method. Analysis of determinate space trusses by tension coefficient method.	6
	TOTAL	42

PRESCRIBED BOOKS

1. Strength of Materials & Mechanics of Structures: Vol. I by Dr. B.C.Punmia Laxmi Publications (p) Ltd.
2. Theory of Structure by Jangid & Negi, Tata Mc Graw Hill.
3. Structural Analysis by Hibbler R.C., Pearsons.

WEEKLY TIME TABLE OF THE TEACHER

First Time Table: with effect from (Date): 22-02-2024

Day	1	2	3	4	5	6	7
Monday	SA II						
Tuesday	SA II						
Wednesday	SA II						
Thursday		SA II					
Friday		SA II					
Saturday							

COURSE-PLAN

UNIT	Lect. No.	TOPICS	Teaching Methods/ Teaching Aids
1	1	INTRODUCTION: Objective, scope and outcome of the course.	White Board
2	2	Deflection of determinate beams and frames	White Board
2	3	Unit Load Method	White Board
2	4	Examples of unit load method	White Board
2	5	Energy methods	White Board
2	6	Strain energy due to Shear force, bending moment and torsion formula and derivation	White Board
2	7	Strain energy method examples	White Board
2	8	Strain energy method examples	White Board
2	9	Castiglione's theorems	White Board
2	10	Castiglione's theorems: applications in analysis of determinate and redundant frames up to two degree of redundancy	White Board
2	11	Castiglione's theorems: applications in analysis of trussed beams	White Board
2	12	Stresses due to temperature	White Board
2	13	lack of fit in redundant frames	White Board
2	14	Examples of complete unit	White Board
3	15	Introduction to Influence line diagram	White Board
3	16	ILD for beams	White Board
3	17	ILD for frames	White Board
3	18	Muller-Breslau principle and its application for drawing ILD	White Board
3	19	Rolling load, maximum stress resultants in a member/section	White Board
3	20	Absolute maximum stress resultant in a structure	White Board
4	21	Introduction to arches, comparison between cables and arches	White Board
4	22	Type of arches	White Board

4	23	Analysis of three hinged arch with example	White Board
4	24	Analysis of three hinged arch with example	White Board
4	25	Analysis of two hinged arch with example	White Board
4	26	Analysis of two hinged arch with example	White Board
4	27	Analysis of fixed arch with example	White Board
4	28	Analysis of arch at different level with example	White Board
4	29	Examples of complete unit	White Board
5	30	Definition and explanation of Unsymmetrical bending	White Board
5	31	Product of inertia and its connection with principle axis	White Board
5	32	Bending stress in beam subjected to unsymmetrical bending	White Board
5	33	Location of neutral axis	White Board
5	34	Computation of stresses and deflection, shear centre and its location	White Board
5	35	Computation of stresses and deflection, shear centre and its location	White Board
5	36	Examples of Unsymmetrical bending	White Board
5	37	Examples of Unsymmetrical bending	White Board
6	38	Introduction to the unit	White Board
6	39	Analysis of multistory frames by portal method	White Board
6	40	Analysis of multistory frames by cantilever method	White Board
6	41	Analysis of multistory frames by factor method	White Board
6	42	Analysis of determinate space trusses by tension coefficient method	White Board

Signature of Faculty: **Signature of HOD**

Assignment – 1

1. Explain the unit load method for calculating deflections in determinate structures. Illustrate its application by determining the deflection at the midpoint of a simply supported beam subjected to a uniform distributed load (UDL).
2. Discuss the concept of strain energy in structural analysis. Derive the expression for strain energy stored in a beam due to bending and demonstrate how it can be used to calculate deflections using Castigliano's theorem.
3. Define the Muller-Breslau principle and explain its significance in structural analysis. Using this principle, draw the influence line diagram for the shear force at a specific section of a simply supported beam. Analyze a simply supported beam subjected to multiple rolling loads.
4. Discuss how influence line diagrams can be used to determine the maximum bending moment and shear force at any section of the beam.

Assignment – 2

1. Compare and contrast the analysis of three-hinged, two-hinged, and fixed arches. Discuss the factors affecting the horizontal thrust in each type of arch and solve for the horizontal thrust in a three-hinged parabolic arch under a uniform load.
2. Explain the significance of the rise-to-span ratio in parabolic arches. Analyze the effects of support settlement on the internal forces in a two-hinged arch with supports at different levels.
3. Describe the concept of unsymmetrical bending and its effects on structural members. How do you locate the neutral axis in such cases? Provide a step-by-step procedure to calculate the stresses and deflections in a beam subjected to unsymmetrical bending.
4. Define shear center and explain its importance in the analysis of thin-walled sections. Determine the location of the shear center for an unequal angle section and discuss the implications of its position on the structural behavior.
5. Describe the portal method and its application in the analysis of multistory frames under lateral loads. Provide a detailed example showing the step-by-step process of analyzing a simple frame using this method.

SAMPLE QUIZ QUESTIONS

1) The unit load method is primarily used to calculate:
a) Shear forces
b) Bending moments
c) Deflections in structures
d) Axial forces

Answer: (c) Deflections in structures

2) Castigliano's second theorem is applicable to:
a) Linear elastic structures
b) Non-linear structures
c) Plastic analysis of structures
d) Determination of buckling loads

Answer: (a) Linear elastic structures

3) Strain energy due to shear force in a beam is typically:
a) Negligible compared to bending energy
b) Equal to the strain energy due to axial loads
c) Always greater than the strain energy due to bending
d) None of the above

Answer: (a) Negligible compared to bending energy

4) The Muller-Breslau principle is used to determine:
a) The shape of influence lines
b) Maximum deflection in beams
c) Shear force and bending moment distribution
d) Stability of arches

Answer: (a) The shape of influence lines

5) In influence line diagrams, the ordinate at any point gives the:
a) Bending moment at that point
b) Shear force at that point
c) Influence of a unit load placed at that point
d) Deflection of the structure

Answer: (c) Influence of a unit load placed at that point

6) The absolute maximum bending moment in a simply supported beam under a series of concentrated rolling loads occurs:
a) Under the largest load
b) At the center of the beam
c) At the point of maximum influence line ordinate
d) At the point of load application

Answer: (c) At the point of maximum influence line ordinate

7) In a three-hinged arch, the horizontal thrust is:
a) Independent of the loading
b) Dependent on the shape of the arch
c) Always zero
d) Dependent on the span and rise of the arch

Answer: (d) Dependent on the span and rise of the arch

8) The analysis of a two-hinged arch is considered:
a) Statically determinate
b) Statically indeterminate to the first degree
c) Unstable
d) Impossible without numerical methods

Answer: (b) Statically indeterminate to the first degree

9) The horizontal thrust in a fixed arch is generally:
a) Less than that in a two-hinged arch
b) Greater than that in a three-hinged arch
c) Zero
d) Dependent on the degree of indeterminacy

Answer: (b) Greater than that in a three-hinged arch

10) The neutral axis (NA) in unsymmetrical bending is:
a) Always at the centroid
b) Perpendicular to the plane of loading
c) Dependent on the geometry and loading
d) Parallel to the major axis of the section

Answer: (c) Dependent on the geometry and loading

11) The shear center of a section is the point where:
a) The bending moment is maximum
b) The resultant shear force causes no twisting
c) The deflection is zero
d) The shear force is minimum

Answer: (b) The resultant shear force causes no twisting

12) In a channel section, the shear center is located:
a) At the centroid of the section
b) Outside the section
c) At the geometric center of the flange
d) Along the neutral axis

Answer: (b) Outside the section

13) The portal method is best suited for:
a) Low-rise buildings with uniform lateral loads
b) Tall buildings with large variations in load
c) Statically determinate frames
d) Space trusses

Answer: (a) Low-rise buildings with uniform lateral loads

14) In the cantilever method, the lateral load is assumed to:

a) Be resisted by all columns equally
b) Cause rotation at the base of the structure
c) Be resisted primarily by the exterior columns
d) Cause no deformation in the beams

Answer: (c) Be resisted primarily by the exterior columns

15) The tension coefficient method is used in the analysis of:

a) Multistory frames under lateral loads
b) Statically determinate space trusses
c) Unsymmetrical bending of beams
d) Shear force in beams

Answer: (b) Statically determinate space trusses

Mid Term Paper-I

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH 3rd – YEAR (VI SEM.) – MT-I

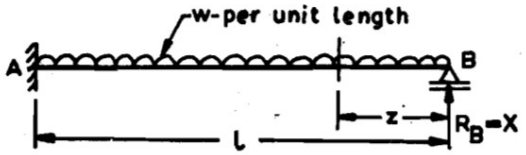
STRUCTURAL ANALYSIS-II (**6CE4-02**)

Time: 2 Hr **Max. Marks:**70

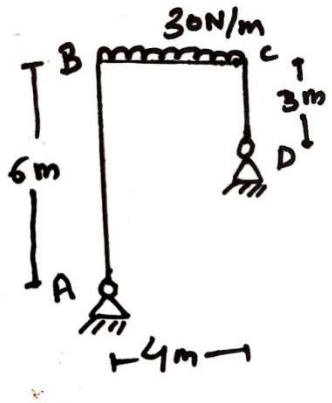
Note:

1) The paper is divided into 2 parts: Part-A and, Part-B.
2) Part-A contains 10 questions and carries 2 mark each.
3) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

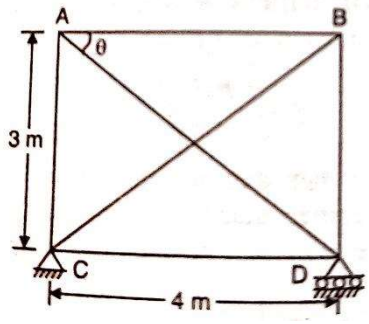
Part- A (20 Marks)

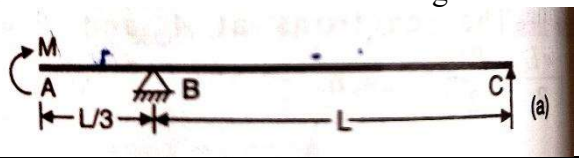
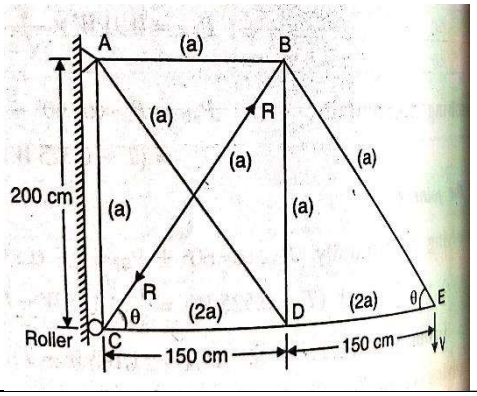
A.	Define Muller-Breslau principle.	CO1
B.	Draw ILD for Reactions at support, Shear force at center and bending moment at center for simply supported beam.	CO1
C.	Explain Castiglione's theorems.	CO1
D.	What is the unit load method?	CO1
E.	What is the influence line? Explain.	CO2
F.	Explain determinate and indeterminate structure.	CO2
G.	Write formulas and derivation for strain energy due to axial force and bending moment and twisting moment.	CO2
H.	Two point loads of 100 KN and 200 KN spaced 3m apart cross a girder of span 12m with 100 KN leading. Draw ILD for shear force at 4m from left and evaluate maximum shear force.	CO2
I.	What is the minimum potential energy theorem?	CO3
J.	Find the reaction at the prop end of the propped cantilever beam loaded as shown in figure. 	CO3

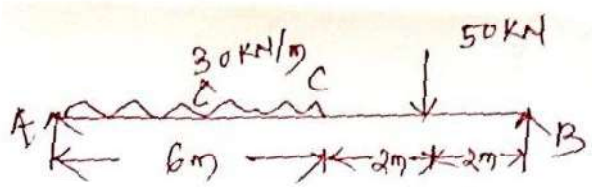
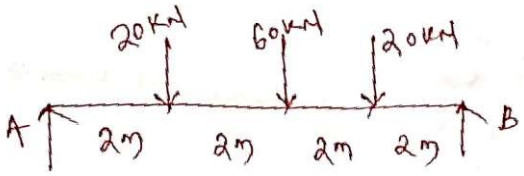
Part- B (50 Marks)

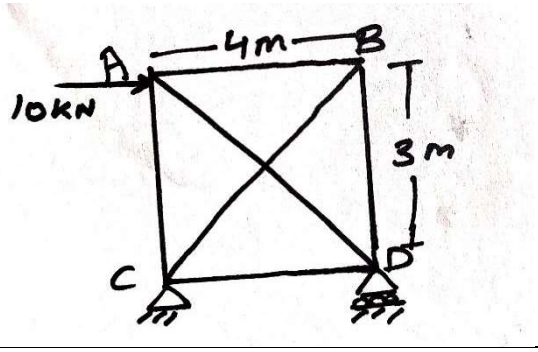
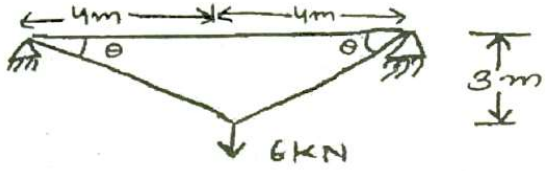
1. Analyse the frame shown in figure carrying a UDL of 30 N/m using minimum potential energy method and draw the bending moment diagram. AB=6m, BC=4m, CD=3m. 	CO1
OR	

1. Four wheel loads of 6, 4, 8, 5 kN cross a girder of 20m span from left to right followed by a UDL of 4kN/m and 4m long with 6kN leading. The spacing between the loads in the same order is 3m, 2m, 2m respectively. The head of UDL is 2m from the last 5kN load. Using ILD, calculate the SF and BM at 8m from the left support when 4kN is at the center of the span.	CO1

2. A beam ABC is supported at A, B and C and has a hinge at D distant 3m from A. AB=7m, BC=10m. Draw ILD for: (i) Reactions at A, B and C. (ii) SF at a point just right of B. (iii) BM at a section 1m to right of B. Also calculate the maximum values of all the ILD for a given loading of a UDL of intensity 2kN/m and length 3m.	CO1
OR	
2. Find the forces in all members of the frame shown in Figure if the member BC is short in length by 10mm and is forced in position. take E=2*10^5 n/mm^2 and A= 100 mm^2  	CO1

3. Using Castigliano's first theorem, determine the deflection and rotation of the overhanging end A of the beam as shown in figure.  	CO2
OR	
3. Find the axial force in the member BC of the frame shown in Figure. The figure in brackets indicates the cross-sectional area in cm2. The members are all of the same material.  	CO2

4. A simply supported beam is loaded as shown below. Determine support reaction, shear force and bending moment at point C using ILD. 	CO2
OR	
4. A simply supported beam of span 8m is loaded as shown below. Find the shear force and bending moment at section 4m from left end. Draw ILD for support reaction, shear force and bending moment. 	CO2

5. Find the force in the member BC of the frame loaded as shown in figure. All members have same cross-sectional area. 	CO3
OR	
5. Determine the vertical and horizontal displacement of the point C of the pin - Joined frame shown in fig. The cross - sectional area of AB is 125 sq.mm and of AC and BC 175 sq mm each $E=2x10^5$ N/mm^2? 	CO3

Marks and Gap Analysis of Mid-Term I

S.No.	University Roll No.	Name of Student	Mid-Term 1 MM-70	Remark (Remedial Class need or not – Y/N)
1.	21ETCCE001	Dev Vaishnav	47	N
2.	21ETCCE002	Hitesh Sutradhar	43	N
3.	21ETCCE004	Naved Khan	52	N
4.	21ETCCE006	Pushpendra Gehlot	54	N
5.	21ETCCE007	Shalin Dak	43	N
6.	21ETCCE009	Tamanna Kumawat	56	N
7.	21ETCCE300	Muniraj Sharma	61	N
8.	22ETCCE200	Moiz Udaipurwala	47	N
9.	22ETCCE201	Vikas Suthar	50	N

*(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

Remedial Action Taken to Remove the Gaps (After Mid- Term 1)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

Signature of Faculty: **Signature of HOD**

Mid Term Paper-II

TECHNO INDIA NJR INSTITUTE OF TECHNOLOGY, UDAIPUR

B. TECH 3rd – YEAR (VI SEM.) – MT-II

STRUCTURAL ANALYSIS-II (**6CE4-02**)

Time: 3 Hr **Max. Marks:**70

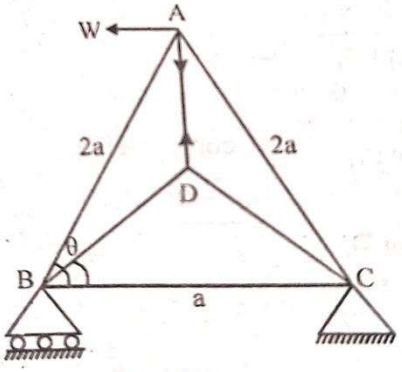
Note:

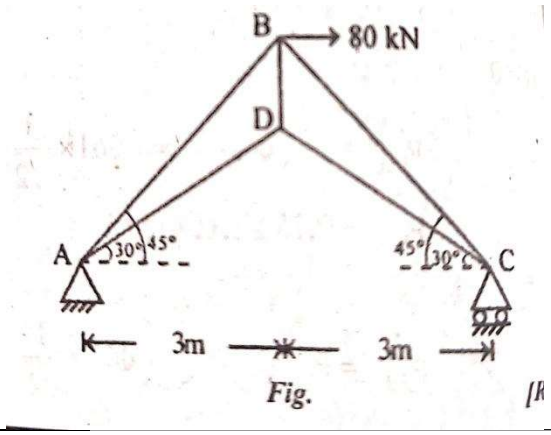
4) The paper is divided into 2 parts: Part-A and, Part-B.
5) Part-A contains 10 questions and carries 2 mark each.
6) Part-B contains 5 questions. Each question is having two options and carries 10 marks each.

Part- A (20 Marks)

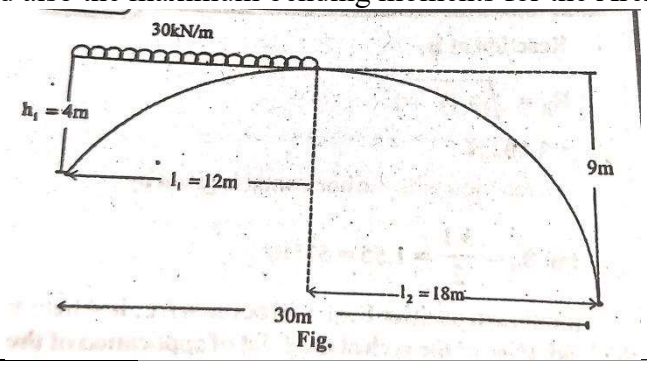
K.	Define strain energy of the member.	CO1
L.	Explain lack of fit in a framed structure and how to evaluate the stresses	CO1
M.	A simply supported beam of span 10 m carries a UDL of 20 KN/m over its central 4 m span. With help of ILD find shear force at 3 m from left.	CO2
N.	What is the difference between arches and cables?	CO2
O.	What is normal thrust and radial shear in arches? Compute the formula.	CO3
P.	Name the type of arches and calculate their indeterminacy.	CO3
Q.	Write the flexural formula.	CO4
R.	Write about center of gravity and moment of inertia.	CO4
S.	Write the three methods for analysis of frames subjected to horizontal loading and also write principle on which they are based.	CO5
T.	Explain tension coefficient method with the formula	CO5

Part- B (50 Marks)

1. Determine the axial forces in the member of pin jointed frame as shown in figure. The cross sectional area of bars AB & AC is '2a' and that of other members is 'a'.  *Fig.*	CO1
OR	

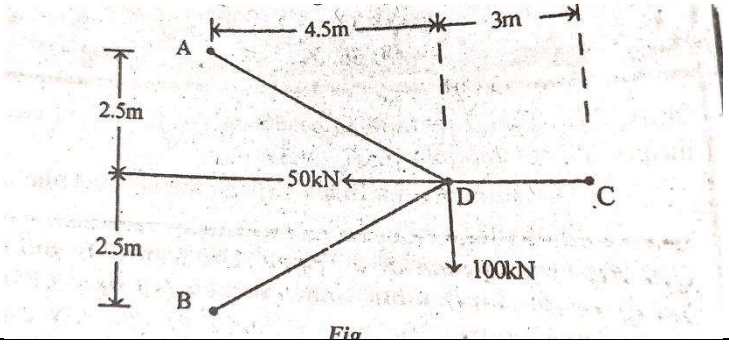
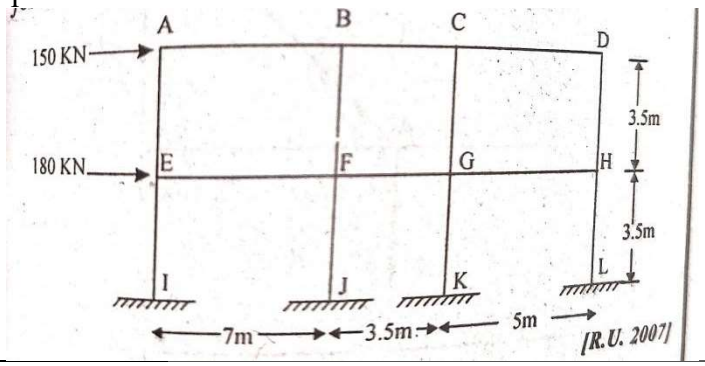
3. Determine the horizontal deflection of roller support C of the frame shown in figure due to applied load of 80 KN being applied at B. Area of members AB, BC and BD are each of 800 mm^2 and AD and CD are each of 1600 mm^2 area. Take E= 2.06 x 10^5 N/mm^2.  Fig.	CO1

4. Four wheel load of 6,4,8 and 5 KN cross a girder of 20 m span from left to right followed by a UDL of 4 KN/m and 4 m long. The load of 6 KN is leading. The spacing between the loads in same order 3 m, 2 m, and 2m followed by head of udl at 2m from 5 KN load. Calculate the S.F. and B.M. at 8 m from left support when 4 KN load is at center of the span using influence lines.	CO2
OR	
2. A beam ABC is simply supported at A, B, and C and has hinge at D located at center of BC, AB= 6 m, BC= 8m. Draw influence line diagram for reactions at A, B and C and for shear force at B. Calculate the maximum values of these quantities if an uniformly distributed load of 10 KN/m and length 4 m crosses the beam from left to right.	CO2

5. A symmetrical three hinged parabolic arch of span 'l' and rise 'h' carries a point load 'W' which may be placed anywhere on the span. Determine the section where maximum bending moment occurs.	CO3
OR	
3. A three hinged parabolic arch ABC of span 30 m has its support A and B at different levels. A being at a higher level than B. the support A is 4 m below the crown hinge C and 12 m horizontally from A. Find the depth of the support B below the hinge C. If the arch carries a UDL of 30 KN/m from A to C. Determine the horizontal thrust and the vertical reactions at the supports. Find also the maximum bending moments for the Arch.  Fig.	CO3

4. A beam of rectangular cross section 80 mm wide and 120 mm deep is subjected to a bending moment of 12 KN-m. The trace of the plane of loading is inclined at 45^0 to Y-Y axis of the section. Locate the neutral axis of the section and calculate maximum bending stress induced in the section.	CO4

OR	
4. Determine the principle moments of inertia for an unequal angle section 200 mm x 150 mm x 10 mm.	CO4

6. In the given figure, plan of a tripod is shown. The feet A, B, and C being in the same horizontal plane and apex D being 3.25 m above the plane. Horizontal force of 100 KN and 50 KN are applied at D in the direction shown in figure. Find the forces in member assuming that all joints are pin joints. 	CO5
OR	
6. Analyze the building frame, subjected to horizontal forces as shown in figure. Use portal method. 	CO5

Marks and Gap Analysis of Mid-Term II

Sr. No.	University Roll No.	Name of Student	Mid-Term 2 MM-70	Remark (Remedial Class need or not – Y/N)
1.	21ETCCE001	Dev Vaishnav	46	N
2.	21ETCCE002	Hitesh Sutradhar	42	N
3.	21ETCCE004	Naved Khan	51	N
4.	21ETCCE006	Pushpendra Gehlot	53	N
5.	21ETCCE007	Shalin Dak	42	N
6.	21ETCCE009	Tamanna Kumawat	55	N
7.	21ETCCE300	Muniraj Sharma	60	N
8.	22ETCCE200	Moiz Udaipurwala	46	N
9.	22ETCCE201	Vikas Suthar	49	N

*(Y, if obtained marks are <50%)

Signature of Faculty: **Signature of HOD**

Remedial Action Taken to Remove the Gaps (After Mid- Term 1I)

S.no.	University Roll no.	Name of Student	Topics to be discussed in Remedial Class	Schedule Date of Remedial Class	Outcome Achieved
1.	NIL				
2.					

Signature of Faculty: **Signature of HOD**

Model Question Paper

6E1542

Roll No. _____ [Total No. of Pages : 3]

6E1542

B.Tech. VI Sem. (Main/Back) Examination, June - 2022

Civil Engg.

6CE4-02 Structural Analysis - II

Time : 3 Hours **Maximum Marks : 120**

Min. Passing Marks : 42

Instructions to Candidates:

*Attempt **all ten** questions from **Part A**, **five** questions out of **Seven** from **Part B** and **Four** questions out of **Five** from **Part C**.*

Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.

Use of following supporting material is permitted during examination (As mentioned in form No. 205)

Part - A

(Answer should be given up to 25 words only)

All questions are **compulsory.** **(10×2=20)**

Write short notes on following:

1. Influence line.
2. Determinate structure.
3. Redundant Frame.
4. Shear centre.
5. Strain energy for impact loads.
6. Unsymmetrical bending.
7. Cantilever method.
8. Unit load method.
9. Fixed type parabolic arches.
10. Muller Breslau principle.

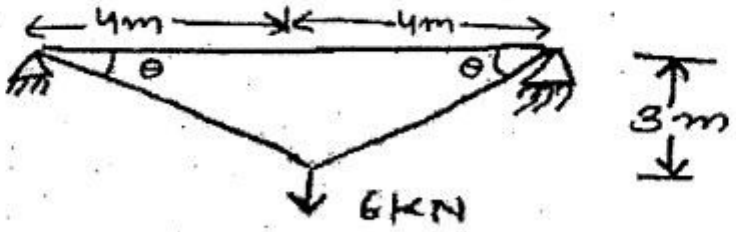
Part - B

(Analytical/Problem solving questions)

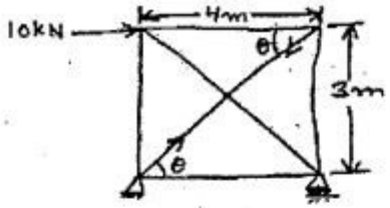
Attempt any **five** questions. **(5×8=40)**

1. Two wheel loads of 16 and 8 kN, at a fixed distance apart of 2m, cross a beam of 10 m span. Draw the influence line for bending moment and shear force for a point 4 m from the left abutment, and find the maximum bending moment and shear force at that point.

2. Determine the vertical and horizontal displacement of the point C of the pin - joined frame shown in fig The cross - sectional area of AB is 100 sq.mm and of AC and BC sq mm each $E = 2\times10^5 N/mm^2$.



3. Find the force in the member BC of the frame loaded as shown in fig. All the members have the same cross sectional area.



4. Explain cantilever method for analysis of multistory frames.

5. A 60 mm × 40 mm × 6 mm unequal angle is placed with the longer leg vertical and is used as a beam simply supported at the ends, over a span of 2 m. If It carries a uniformly distributed load of such magnitude as to produce the maximum bending moment of 0.12 kN-m determine the maximum deflection of the beam. Take $E = 2.1\times10^5 N/mm^2$.

6. Derive the expression of three hinged parabolic Arch.

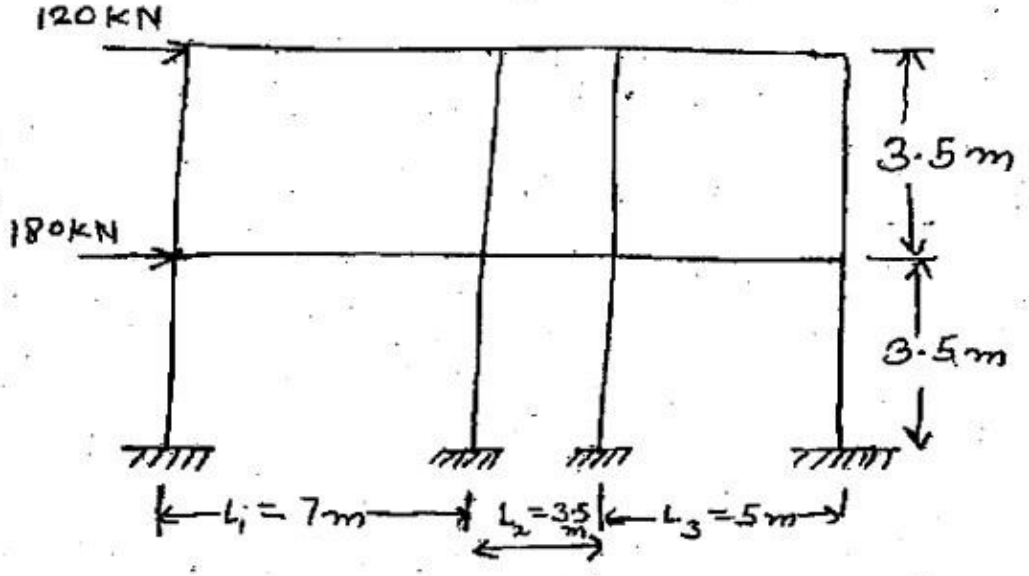
7. A freely supported beam of span L carries a central load W. The sectional area of the beam is so designed that the moment of Inertia of the section increases uniformly from I at ends to 1.5 I at the middle. Calculate the central deflection.

Part - C

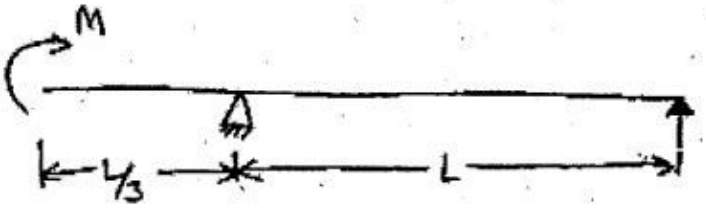
(Descriptive/Analytical/Problem Solving/Design questions)

Attempt any **Four** questions. **(4×15=60)**

1. A parabolic arch, hinged at the ends has a span 30 m and rise 5m. A concentrated load of 12 kN acts at 10 m from the left hinge. The second momnet of area varies asthe secant of the slope of the rib axis. Calculate the horizontal thrust and reactions at the hinges. Also, calculate the maximum bending moment any where on the arch.
2. Four wheel loads of 6,4, 8 and 5 kN cross a girder of 20 m span, from left to right followed by U.D.L of 4 kN/m and 4m long with the 6 kN load leading. The spacing between the loads in the same order are 3m, 2m and 2m. The head of the U.D.L. is at 2m from the last 5 kN load. Using influence lines, calculate the S.F. and B.M. at a section 8 m from the left support when the 4kN load is at centre of the span.
3. Analyse the building frame, subjected to horizontal forces as shown in fig use portal method.



4. Using castigliano's first theorem, determine the deflection and rotation of the overhanging end A of the beam loaded as shown in fig.



5. Explain Muller - Breslau principle and its application for drawing ILD.

STUDENT PERFORMANCE REPORT

Roll No.	Name of Student	I Mid-Term	II Mid-Term	Average
21ETCCE001	Dev Vaishnav	47	46	46.5
21ETCCE002	Hitesh Sutradhar	43	42	42.5
21ETCCE004	Naved Khan	52	51	51.5
21ETCCE006	Pushpendra Gehlot	54	53	53.5
21ETCCE007	Shalin Dak	43	42	42.5
21ETCCE009	Tamanna Kumawat	56	55	55.5
21ETCCE300	Muniraj Sharma	61	60	60.5
22ETCCE200	Moiz Udaipurwala	47	46	46.5
22ETCCE201	Vikas Suthar	50	49	49.5

Signature of Faculty: **Signature of HOD**

RESULT ANALYSIS

S.NO.	RTU ROLL NUMBER	NAME OF STUDENT	END TERM MARKS	SESSIONAL MARKS	TOTAL
		MAX MARKS	**70**	**30**	**100**
1.	21ETCCE001	Dev Vaishnav	Result pending	21	
2.	21ETCCE002	Hitesh Sutradhar	Result pending	19	
3.	21ETCCE004	Naved Khan	Result pending	23	
4.	21ETCCE006	Pushpendra Gehlot	Result pending	24	
5.	21ETCCE007	Shalin Dak	Result pending	19	
6.	21ETCCE009	Tamanna Kumawat	Result pending	25	
7.	21ETCCE300	Muniraj Sharma	Result pending	27	
8.	22ETCCE200	Moiz Udaipurwala	Result pending	21	
9.	22ETCCE201	Vikas Suthar	Result pending	22	

TOTAL	PASS	FAIL	ABSENT	PASS %
9				

Indirect Assessment:

Overall Teacher Self-Assessment (at the completion of course) in terms of course objective and outcomes

Course Objectives:

It aims to deepen students' understanding of advanced structural analysis techniques essential for civil engineering. It covers the unit load method for deflection analysis, energy methods for evaluating strain energy under various loading conditions, and the application of Castigliano's theorems to both determinate and indeterminate structures. Students will learn to construct and interpret influence line diagrams, analyze the effects of rolling loads, and study the behavior of arches under different support conditions. Additionally, the course introduces unsymmetrical bending, focusing on the computation of stresses and the location of the shear center. Approximate methods for analyzing multistory frames subjected to lateral loads, as well as the tension coefficient method for space trusses, are also explored. Through this course, students will develop the analytical skills necessary to solve complex structural problems, preparing them for professional practice in civil engineering.

Course Outcomes:

At the end of this course students will be able to:

CO1: Students will be able to calculate deflections in determinate and indeterminate structures using the unit load method and energy methods.

CO2: Students will be proficient in analyzing and interpreting influence line diagrams for beams and frames under various loading conditions.

CO3: Students will understand the analysis of three-hinged, two-hinged, and fixed arches, including the calculation of horizontal thrusts.

CO4: Students will be able to analyze the effects of unsymmetrical bending, including locating the neutral axis and calculating resulting stresses and deflections.

CO5: Students will gain the ability to apply approximate methods like the portal and cantilever methods to analyze multistory frames under lateral loads.

Methodology to identify bright student

It is done by considering a range of criteria, including academic performance, creativity, critical thinking, problem-solving skills, and enthusiasm for learning. Bright students often excel in multiple areas. Observed how students perform in the classroom. In terms of active participation, engagement in discussions, leadership, and the ability to grasp complex concepts.

Efforts to keep students engaged

1. Active Learning:

- Incorporate active learning strategies, such as group discussions, problem-solving activities, and hands-on projects. Active participation keeps students engaged and encourages critical thinking.

2. Varied Teaching Methods:

- Use a variety of teaching methods, including lectures, group work, multimedia presentations, and interactive activities to cater to different learning preferences.

3. Technology Integration:

- Leverage technology, such as online platforms, educational apps, and interactive software, to make lessons more engaging and interactive.

Methodology to identify weak student

It is done by considering a range of criteria, including classroom observation, formative assessment, summative assessment, assignment review etc. Weak students are struggling students with sensitivity and a desire to support their learning. Some measures, such as additional tutoring, personalized assignments, or alternative assessment methods, to help students succeed.

Targeted inventions for weak student

1. Additional Resources
Offer supplementary learning materials, such as textbooks, online resources, or multimedia content, to provide alternative explanations and reinforce key concepts.

2. Remedial classes
Establish a tutoring program where students can receive extra help from teachers.

3. Flipped classroom
Students are assigned pre-class learning materials, often in the form of videos, readings, or online modules, to cover the foundational concepts before coming to class.