NITDGP/BTech/Reg./Even /2021-22

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-Term Examination, 2021-2022

Course Code: CEE621 Full Marks: 30

Course Name: FINITE ELEMENT METHOD Time: 90 Minutes

Question Paper No. NITDGP/CEE621/1 Date: 22/04/2022

*Instructions: Attempt any **THREE** questions from each group.*
Notations have their usual meanings if not mentioned otherwise.

Question No.	Body of the Question	Marks	Mapped CO
	Group-A		
1	a) Explain why pre-processing is more important than post-processing in FEM b) Sate with element stiffness matrices Two standard *finite elements*	3 2	CO1
2	a) Using equilibrium approach derive the global stiffness matrix for three *spring elements* connected in series. Use standard symbols in derivation. b) A system is discretized with four spring elements in series. Three intermediate nodes of the discretized system are subjected to forces 0.55kN, 20kN and -55N respectively. Spring constants are 25N/mm, 35N/mm and 10N/mm and 8N/mm respectively. If end nodes are fixed establish the global equilibrium equation. (no solution)	2 3	CO2
3	a) How will you find out element stiffness matrix for a *bar element* Derive the necessary expression. Use standard symbols in the derivation. b) Where do you find FEA to be absolutely necessary?	3 2	CO1
4	a) In FEM convergence study and validation are very important – explain b) Mention some differences between conventional method of analysis and numerical method of analysis.	2.5 2.5	CO1
5	a) Assume a real type structure, discretize the same with a suitable element. Also mention total number of nodes, elements and d.o.fs b) Name three commercial FE software with their area(s) of application.	3 2	CO3
	Group B		
6	a) "Degrees of freedom (DOF) of any elastic structure is only dependant on the number of supports": justify/rectify the comment in light of FEA using a suitable example. b) In the beam element of Fig.Q6, the length is L, cross section is A and flexural rigidity is EI. Derive the **second column** of the element stiffness matrix (ESM) using direct approach.	2 3	CO1

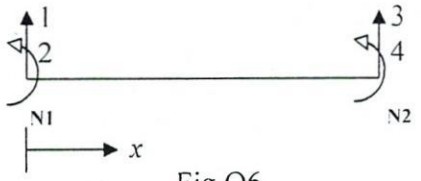
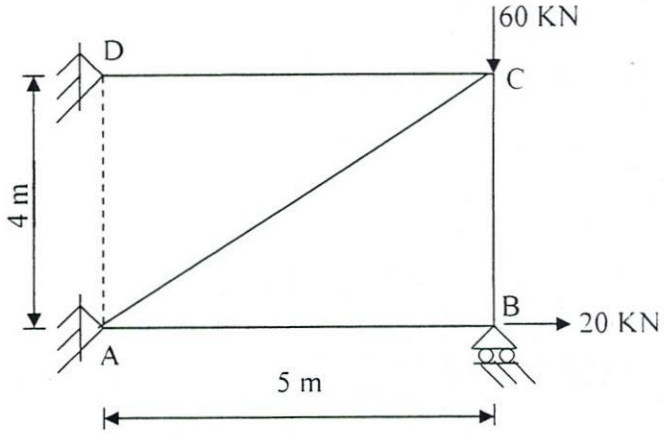


Fig.Q6

7	a) Discretise the system of Fig. Q7 and mention the node numbers and element numbers clearly. Show, in a separate figure, the global degrees of freedom at the nodes. b) Form the global load vector and global displacement vector of the system. Explain clearly the boundary conditions.  Fig. Q7	3 2	CO2
8	a) With reference to FEA of a typical civil engineering structure, what is the general utility of the "Transformation Matrix"? Show a simple application where it is used. b) Develop the element stiffness matrix (ESM) in the global coordinate system (GCS) for the member BC of Fig. Q7; start from the ESM in the local coordinate system (LCS). Area of c/s and modulus of elasticity are ***A*** and ***E*** respectively for each member.	2 3	CO3
9	A cantilever beam, of length ***L*** and constant ***EI***, is supporting a downward concentrated moment M_0 at the free end. a) Model this beam by FEM using the minimum number of element (s). Hence write down the governing equation in matrix form. b) Compute the unknown displacements.	 3 2	CO3
10	a) A beam element as shown in Fig. Q6 is under a linearly varying load that starts from ***zero*** at node 1 and reaches ***q/unit length*** at node 2. Starting from the relevant general expression, find out the equivalent nodal load vector. **No derivation** is required. The following shape functions may be used with reference to Fig. Q6 $N_1 = 1 - (3x^2/L^2) + (2x^3/L^3)$, $N_2 = x - (2x^2/L) + (x^3/L^2)$, $N_3 = (3x^2/L^2) - (2x^3/L^3)$, $N_4 = (x^3/L^2) - (x^2/L)$ b) With reference to the beam in Q9 above, find out the displacements at the centre of the beam.	3 2	CO2

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CEE623
Course Name: Remote Sensing & GIS
Question Paper No.: NITDGP/CEE623/1

Full Marks: 30
Time: 1½ Hours
Date of Exam: 22/04/2022

Instructions: Answer **any ten** questions.

Question No.	Body of the Question	Marks	Mapped CO
1	Give examples of three GIS applications in each of the following fields: (a) Environmental & natural resources management (b) Road network.	3	CO3
2	What do you understand by the following features in maps? (a) Cadastral; (b) Topographical; (c) Cultural.	3	CO3
3	What is a geodetic datum? What are the roles played by different types of geodetic datum?	1+2	CO2
4	What do you understand by the term 'topology' in GIS? Discuss any two elements of topology.	1+2	CO3
5	What do you understand by the following errors in vector data? (a) Undershoot; (b) Overshoot; (c) Sliver polygon.	3	CO3
6	Discuss the functions of data processing subsystem of GIS with reference to a project on developing a site for a new township.	3	CO3
7	(a)What is the concept of map projection? (b)What are the different types of scale used in GIS? Show with examples.	1+2	CO3
8	What do you understand by the following terms? (a) Spheroid (b) Geoid (c) Datum.	3	CO2
9	Show the different formats of features considered in the following with examples: (a) Conceptual data model; (b) Logical data model.	3	CO3
10	(a) What do you understand by the terms – slope & aspect? (b) What is the difference between DTM & DEM?	2+1	CO3

Course Outcomes
CO1: Learn about basic items, parameters & concepts related with remote sensing.
CO2: Apply techniques of visual image interpretation and digital image processing.
CO3: Use GIS and its components for basic applications in civil engineering.

11	What do you understand by the term UTM used in GIS? How are eastings & northings measured in UTM?	1+2	CO3
12	Show the components of geographic coordinate system with a neat sketch.	3	CO3
13	Why is GIS described as "an integration of spatial & attribute information"?	3	CO3
14	What do you understand by 'dynamic updating' ability of GIS maps?	3	CO3
15	State three limitations of GIS.	3	CO3

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NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

Even Semester End-term Examination, 2021-22

Course Code: CEE610
Course Name: Advanced Design of Concrete Structures
Question Paper No.: NITDGP/CEE610/40

Full Marks: 30
Time: 90 minutes

Instructions: Answer only Three short answer typed-questions using suitable missing data
Materials to be supplied: IS: 456 – 2000. IS: 875 (III) and IS: 1893 (I) are allowed

Question No.	Body of the Questions	Marks	Mapped CO
1	A 3 stored special R.C. moment resisting hospital building located at NIT Durgapur campus with following details: Bay width = 4 m c/c, Frame spacing = 3 m c/c, Height of ground floor = 4m, Height of other floors = 3.5 m, Floor thickness = 0.15 m, Outer columns = 250 mm x 300 mm, 2 nos, Inner columns = 250 mm x 400 mm, 3 nos, Girder below floor slab = 250 mm x 400 mm, Live load = 5 KN/m^2, Walls are in the frame and resting over hard soil. Plot the deflection of the building due to earthquake.	10	CO3
2	A 5 stored special R.C. moment resisting hospital building located at NIT Durgapur campus with following details: Bay width = 4 m c/c, Frame spacing = 3 m c/c, Height of ground floor = 4m, Height of other floors = 3.5 m, Floor thickness = 0.15 m, Outer columns = 250 mm x 300 mm, 2 nos, Inner columns = 250 mm x 400 mm, 3 nos, Girder below floor slab = 250 mm x 400 mm, Live load = 5 KN/m^2, Walls are in the frame and resting over hard soil. Plot the deflection of the building due to wind.	10	CO3
3	A drop and column head flat slab consists of 5.5 m x 6.5 m panels subjected to live load of 4.6 KN/m^2 along with a finishing load of 1 KN/m^2. The diameter of column is 550 mm and clear height is 4.8 m with both ends fixed. Calculate and place the moments in any one direction using Fe500 and M30.	10	CO1
4	A 10x0.65x0.35 m^3 M25 grade of reinforced concrete simply supported beam of age 1year carries an all-inclusive load of 30 kN/m out of which 60 % is permanent. After designing the beam, it is found that 5nos and 3nos 25 mm tor-phi bars (HYSD-Fe500) are required at bottom and top respectively. Calculate the final creep deflection at 1/4th span of the beam after one year from the date of construction.	10	CO1
5	Calculate the crack width of the beam (Q.4) at the following points in the mid span: i). bottom corner and ii). at the soffit below the central bar	10	CO1

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Course Outcomes

CO1: Acquire knowledge of engineering design of different Member
CO2: Ability to analyse the Utility Structures: Bunker, Silo, Water Tank, Shell, etc.
CO3: Ability for understanding the need of future studies

NATIONAL INSTITUTE OF TECHNOLOGY DURGAPUR

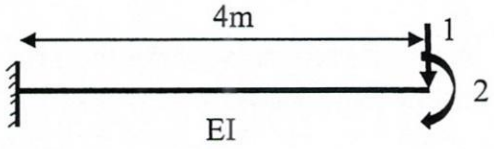
Even Semester End-term Examination, 2021-22

Course Code:CEE611 Full Marks: 30

Course Name: Advanced Structural Analysis Time: 90 Minutes

Question Paper No.: NITDGP/CEE611 Date of Exam: 21/04/2022

Instructions: Answer all the questions. Supporting numerical calculations, wherever applicable, must be shown

Question No.	Body of the Question	Marks	Mapped CO
1	Flexibility matrix is always a) Symmetric b) Non-symmetric c) Anti-symmetric d) Depends upon loads applied	1	CO1
2	The flexibility matrix of the cantilever beam shown in the given figure is  **Figure 1** a) $\begin{bmatrix} \frac{64}{3EI} & \frac{-8}{EI} \\ \frac{-8}{3EI} & \frac{64}{3EI} \end{bmatrix}$ b) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{8}{3EI} & \frac{-64}{3EI} \end{bmatrix}$ c) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{8}{3EI} & \frac{4}{3EI} \end{bmatrix}$ d) $\begin{bmatrix} \frac{64}{3EI} & \frac{8}{EI} \\ \frac{4}{3EI} & \frac{8}{3EI} \end{bmatrix}$	2	CO1

Course Outcomes

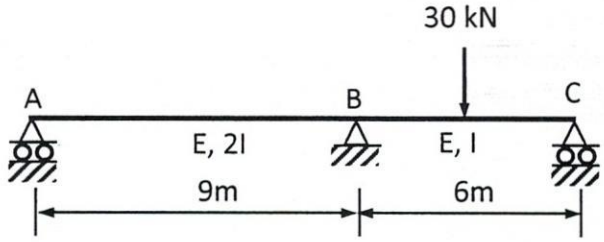
CO1: Develop basic understanding of the fundamental concepts and theorems of the advanced topics in analysis of structures

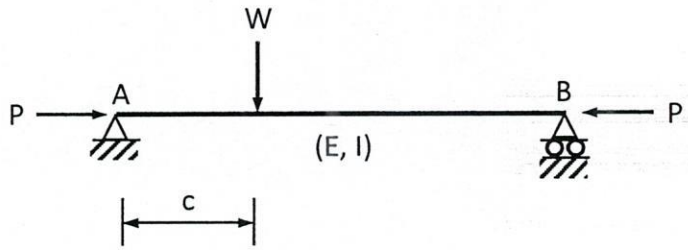
CO2: Model and analyze different structural systems by matrix method of analysis using element approach of force/ flexibility method

CO3: Model and analyze different structural systems by matrix method of analysis using element approach of displacement/ stiffness method

CO4: Understand the basic methodology adopted in developing computer programmes for structural analysis and thus, develop an overall understanding of the available structural analysis softwares

CO5: Write the governing equations for stability and carry out stability analysis of structures

3	***Force/ Flexibility Method of Analysis*** The continuous beam ABC shown in *Figure2* has a hinge support at B and roller supports at A and C. It is acted upon by a load of magnitude 30 kN at the mid-point of span BC.  **Figure 2** For the above structure, answer the following questions:		
a)	Determine the degree of statical indeterminacy. Make the structure determinate, clearly indicating the redundant(s).	1	CO1
b)	Discretize the structure and define i) the global/ system and the local/ member coordinate systems, ii) the force and the load vectors	2	CO1, CO2
c)	Derive the element flexibility matrix for each element	2	CO1, CO2
d)	Write down the unassembled flexility matrix for the structure, clearly indicating the coordinates	1	CO2
e)	Determine the Transformation Matrix part $[A_{ml}]$	3	CO2
f)	Determine the Transformation Matrix part $[A_{mR}]$	2	CO2
g)	Combine above two Transformation Matrices to form the Transformation Matrix $[A_{mS}]$, clearly indicating the coordinates	1	CO2
h)	Determine the assembled flexibility matrix $[F_S]$	3	CO2
3	For a beam-column subjected acted upon by axial load and transverse loads, the critical load e) Increases with the magnitude of transverse loads f) Decreases with the magnitude of transverse loads g) Does not depend on the magnitude of transverse loads h) Cannot be said; depends on the type of the problem	1	CO1, CO5
4	A simply-supported beam-column member is subjected to an axial compressive load **P** and transverse loads **W** at a distance 'c' from the left end support as shown in *Figure 3*		

	 **Figure 3** For the above structure, answer the following questions:		
a)	Write the moment-curvature equation of the elastic curve.	1	CO5
b)	Write total solution of the equation	3	CO5
c)	State the boundary conditions	1	CO5
d)	Determine the values of the constants of integration	5	CO5
e)	Write the equation of elastic curve	1	CO5