GUJARAT TECHNOLOGICAL UNIVERSITY

7th Semester Civil Engineering - PDDC

Subject Code & Name: X70606 - Advanced Structural Analysis (Department Elective-I)

Sr. No.	Course content
1.	**Stiffness Method (Member Approach):** Overview of different stiffness & rotation-transformation matrices, analysis of beam, truss, plane frame with external load and secondary effects, Analysis of Grid & Space structures under loading & various secondary effects like deformation of support, prestrain & temperature, Analysis of Composite structures having combination of different types members.
2.	**Stiffness Method (Special topics):** Symmetry/Anti-symmetry, Oblique, supports Elastic supports, Axial-flexural interaction. **Nonlinear Analysis:** Concepts of nonlinearity like Material nonlinearity, Geometry nonlinearity & Nonlinear analysis.
3.	**Finite Element Method:** Introduction to FEM, Types of problems, Stresses & Equilibrium, Strain-displacement relations, Stress-strain relations. Application of FEM to One dimensional (bar & beam) problems & two dimensional problems using Constant strain triangles. Two dimensional iso-parametric elements – Four nodded quadrilateral elements, numerical integration, higher order elements.
4.	**Computer Applications:** Algorithm of Stiffness method Member Approach/Finite Element method. Different techniques for solution of equations using matrices, banded matrix, storage techniques for large size problem. Development of computer programs for analysis of skeletal structures using C/C++. Application of professional software for structural analysis and design of real life structures.

Note: All Topics Carries equal weightage.

Term Work: Term work shall consists of

1. Minimum 5 problems from each topics no.1, 2 & 3 & cross checking with any professional software and/or user made program.
2. C/C++ Programs with inputs/outputs for one skeletal structure.
3. Analysis of at least one real-life structure using Professional software.

Useful Software: STAAD-Pro/STRUDS/SAP-2000/STRAP/ETABS/ANSYS/VC++

Text Books:

1. Gere & Weaver ; Matrix Analysis of Framed Structures, CBS Publication
2. Bhavikatti; Finite Element Analysis, New Age International Publishers

Reference Books:

1. Meghre & Deshmukh ; Matrix Analysis of Structures, Charotar Publication
2. Desai & Abel; Finite Element Method, Tata McGraw-Hill
3. S S Khandare; CAD Application
4. Shesa Prakash & suresh, Computer Aided Design Lab, Laxmi Publication.

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GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII EXAMINATION – SUMMER 2016

Subject Code:X70606 **Date:05/05/2016**

Subject Name: Advanced Structural Analysis

Time:02:30 PM to 05:00 PM **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive stiffness matrix for a plane frame with usual notations.	**07**
	(b)	Explain : $[S_{MS}]$, $[S_{RF}]$, $[R_T]$, $\{A_J\}$, $\{A_E\}$, $\{A_{FC}\}$, $\{A_R\}$	**07**
Q.2	**(a)**	Explain in brief steps of analysis of structures using finite element method.	**07**
	(b)	Explain use of Symmetry and Anti-symmetry in analysis of the structures with suitable examples.	**07**
		OR	
	(b)	Explain Material nonlinearity and Geometry nonlinearity with respect to nonlinear analysis.	**07**
Q.3	**(a)**	Find out displacements for the beam shown in fig. 1 using stiffness member approach.	**07**
	(b)	Determine support reactions and member end actions for the Q-3(a)	**07**
		OR	
Q.3	**(a)**	Find out displacements for the plane frame shown in fig. 2 using stiffness member approach. All members have the same EI & EA. Take EA = 120 EI.	**07**
	(b)	Find out displacements for the grid shown in fig. 3 using stiffness member approach. Take GJ = 0.8 EI.	**07**
Q.4	**(a)**	Using symmetry of the structure, determine displacements for the plane truss shown in fig. 4. Use stiffness member approach.	**07**
	(b)	Using stiffness member approach, calculate displacements for the beam as shown in fig. 5, if the beam is subjected to following secondary effects: (i) 0.001 radian clockwise rotation of support A. (ii) 5 mm downward settlement of support B. Take EI = 20×10^3 kNm^2.	**07**
		OR	
Q.4	**(a)**	Derive Stiffness Matrix for two noded bar element using finite element method.	**07**
	(b)	For a bar element as shown in fig. 6, calculate nodal displacements using finite element method. Consider E = 2×10^5 MPa.	**07**
Q.5	**(a)**	Explain plane stress and plane strain conditions giving suitable examples.	**07**
	(b)	Using finite element method, determine vertical displacement and rotation at node-2 of the beam shown in fig. 7. The beam is assumed to have constant EI.	**07**
		OR	
Q.5	**(a)**	Explain any two different loading facilities in the professional software.	**07**
	(b)	Write a C/C++ program of input data required for the analysis of the continuous beam.	**07**

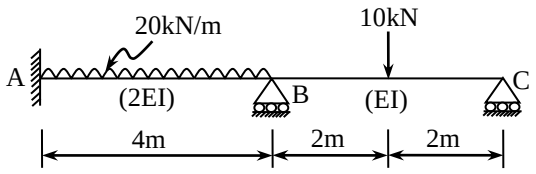

Fig. 1 Q-3(a), Q-3(b)

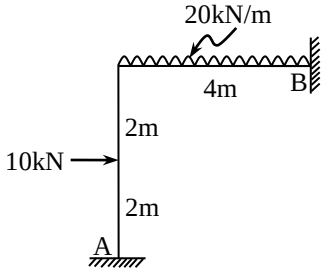

Fig. 2 Q-3(a) OR

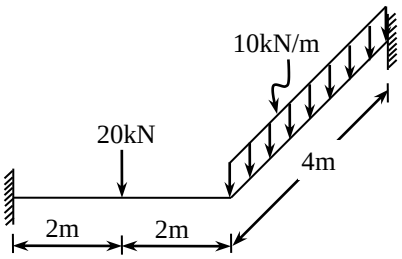

Fig. 3 Q-3(b) OR

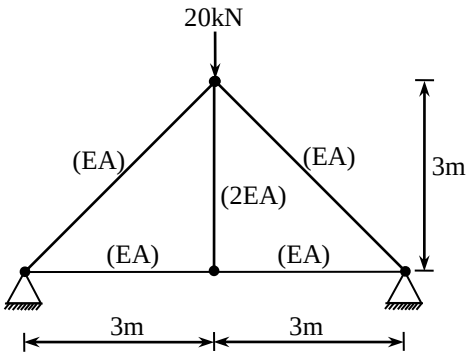

Fig. 4 Q-4(a)

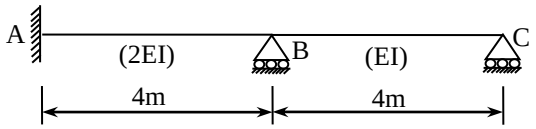

Fig. 5 Q-4(b)

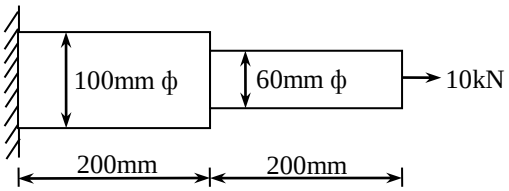

Fig. 6 Q-4(b) OR

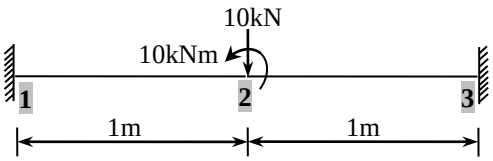

Fig. 7 Q-5(b)

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII EXAMINATION – WINTER 2015

Subject Code:X70606 Date:04/12/2015

Subject Name: Advanced Structural Analysis (Department elective I)

Time: 10:30pm to 1:00pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Explain the process of discretization in finite element method.	**07**
	(b)	Derive the shape function for the constant strain triangle.	**07**
Q.2	**(a)**	Explain the concept of symmetry and antisymmetry with examples.	**07**
	(b)	Write an algorithm for the analysis of simply supported beam by stiffness matrix method.	**07**
		OR	
	(b)	Elaborate the incremental analysis with iteration technique.	**07**
Q.3	**(a)**	Analyse the continuous beam shown in figure (1) and find the assembled stiffness matrix.	**07**
	(b)	Using stiffness approach draw shear force and bending moment diagram for figure (1).	**07**
		OR	
Q.3	**(a)**	Derive the member stiffness matrix for the plane frame.	**07**
	(b)	Find the displacement and rotation at 'B' for the beam as shown in figure (2) by stiffness matrix method. EI = 10000 kN.m^2.	**07**
Q.4	**(a)**	Find the joint displacement at 'B' for the plane frame as shown in figure (3) by stiffness matrix method. I_{zz} = 1.33 x 10^{-4} m^4, A = 0.04 m^2 and E = 200 GPa. EI and EA are same for both the members.	**10**
	(b)	Explain the material and geometric non linearity with examples.	**04**
		OR	
Q.4		Analyse the truss and find the forces in the members as shown in figure (4) by stiffness matrix method. Here support 'B' settles down by 5 mm and temperature in member 'BD' increased by 10^0C. Adopt α = 12 x 10^{-6} ^{0}C and AE = 7000 kN. Length of member CD is 3m, AD is 4m and BD is 5m.	**14**
Q.5		Determine the joint displacement for the grid as shown in figure (5) by stiffness matrix method. The load of 100 kN is acting at the centre of member AB.	**14**
		OR	
Q.5	**(a)**	Explain the convergence requirement of the shape function.	**07**
	(b)	Using the generalized coordinate approach, find the shape function for two noded truss element.	**07**

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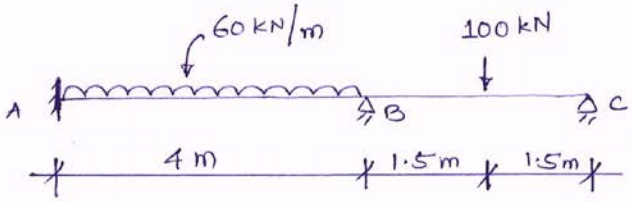

Figure 1 (Q·3(a) and (b))

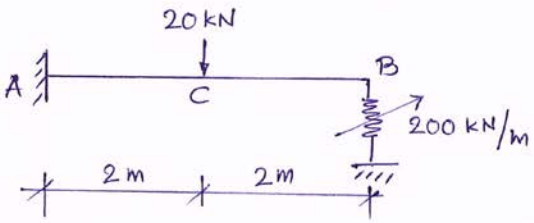

Figure 2 (OR Q·3(b))

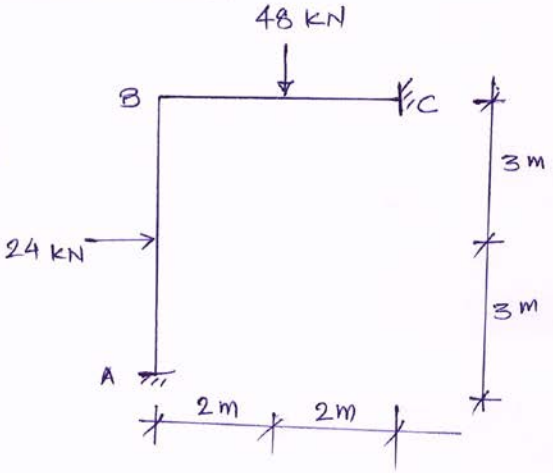

Figure 3 (Q·4(a))

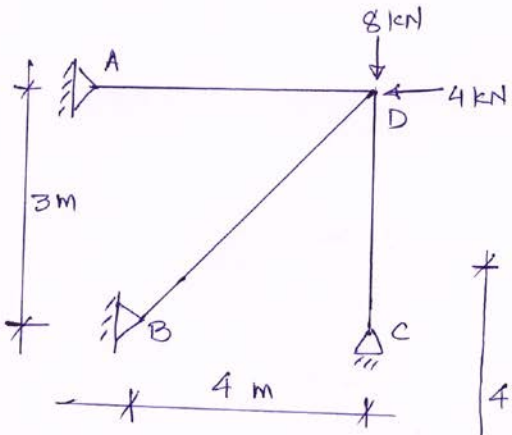

Figure 4 (Q·4)

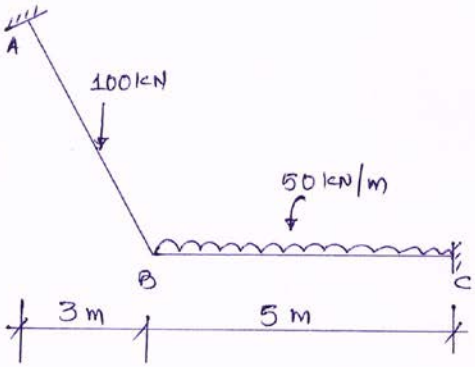

Figure 5 (Q·5)

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GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII • EXAMINATION – SUMMER • 2015

Subject code: X-70606 **Date: 14/05/2015**

Subject Name: Advanced Structural Analysis

Time:02:30 pm - 05:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 Analyse the beam shown in **Figure-1** and draw SFD, BMD. Use Stiffness Member Approach. **14**

Q.2 **(a)** Explain use of Symmetry and Anti-symmetry in analysis of complex structures with suitable example. **07**

(b) Derive $[SMS] = [R_T]^T [SM] [R_T]$ for a plane truss member using usual notations. **07**

OR

(b) Explain any two different loading facilities in the professional software. **07**

Q.3 Analyse the plane truss shown in **Figure-2** using stiffness member approach. Calculate Member end actions. All members have same axial rigidity. **14**

OR

Q.3 Analyse the orthogonal Grid shown in **Figure-3** below and draw SFD, BMD and TMD. Use Stiffness Member Approach. AB=5m, BC=CD= 2m. Consider GJ = 0.8EI for both members. **14**

Q.4 Analyse the Plane frame shown in **Figure-4** using Stiffness Member Approach. **14**

OR

Q.4 Analyse the composite structure shown in **Figure-5.** Calculate member end actions. ABC is a rectangular beam section of size 230 x 300 mm with E = 20000 N/mm^2 BD is a steel bar of diameter 25 mm with E = 2 x 10^5 N/mm^2. **14**

Q.5 **(a)** Derive Stiffness Matrix for two noded bar element using finite element method. **07**

(b) Write basic steps of F.E.M. and explain any one in detail. **07**

OR

Q.5 **(a)** Derive Stiffness Matrix for two noded beam element using finite element method. **07**

(b) Derive shape function for Constant Strain Triangle using usual notations. **07**

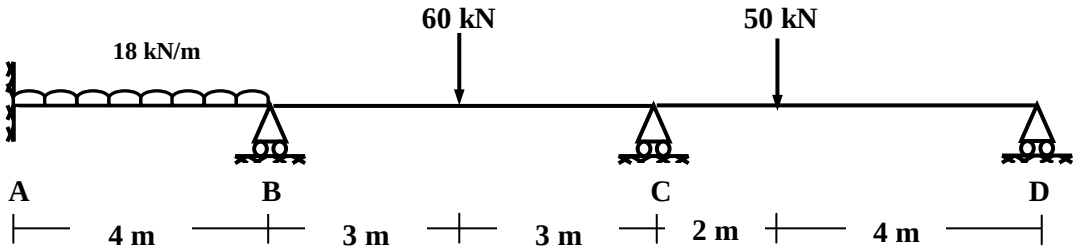

Fig. -1

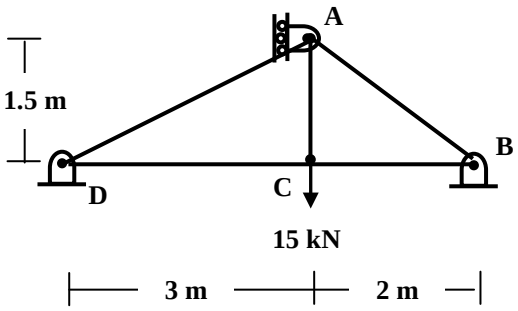

Fig. -2

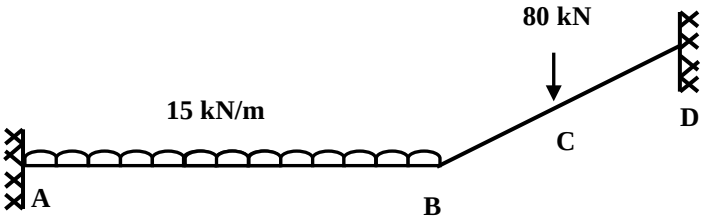

Fig. -3

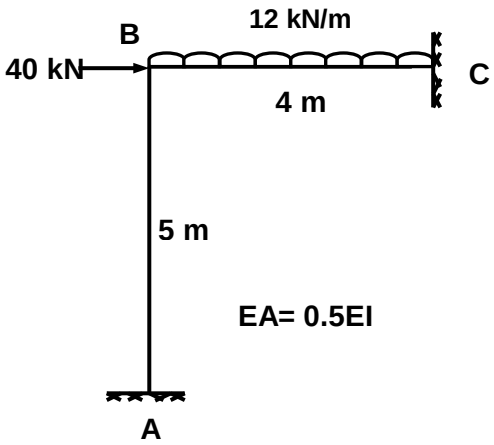

Fig. - 4

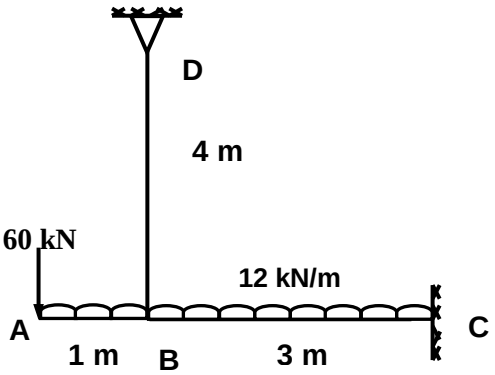

Fig-5

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GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII • EXAMINATION – WINTER • 2014

Subject Code: X 70606 **Date: 05-12-2014**

Subject Name: Advanced Structural Analysis

Time: 10:30 am - 01:00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive Stiffness matrix for a beam with usual notations.	**07**
	(b)	Explain : [Sm], [RT], {AJ}, {AE}, [SFF], {AM}, [SRF]	**07**
Q.2	**(a)**	Explain advantages of Finite Element Method in detail.	**07**
	(b)	Write basic steps of F.E.M. and explain any two in detail.	**07**
		OR	
	(b)	Explain any two different loading facilities in the professional software.	**07**
Q.3	**(a)**	What are the advantages of Stiffness Member approach? Explain in detail.	**04**
	(b)	Analyse the beam as shown in **Figure-1** below and draw BMD. Use Stiffness Member Approach.	**10**
		OR	
Q.3		Analyse the beam as shown in **Figure-1** if Support B is sinking 10 mm in downward direction. Take E = 200 GPa and I = 200 x 10^6 mm^4.	**14**
Q.4	**(a)**	Derive Member stiffness Matrix for truss with usual notations.	**04**
	(b)	Analyse the plane truss as shown in **Figure-2** using stiffness member approach. Calculate Member end actions.	**10**
		OR	
Q.4		Analyse the Plane frame shown in **Figure-3** using Stiffness Member Approach.	**14**
Q.5	**(a)**	Derive Stiffness Matrix for two noded bar element using finite element method.	**07**
	(b)	Explain convergence criteria in detail also explain need of convergence.	**07**
		OR	
Q.5	**(a)**	Derive Stiffness Matrix for two noded beam element using finite element method.	**07**
	(b)	Explain convergence criteria in detail.	**07**

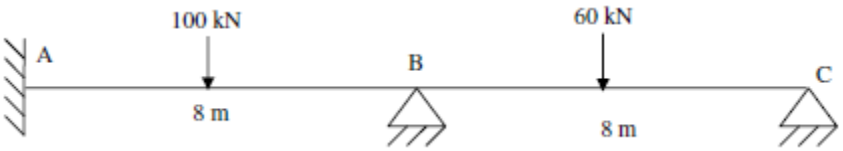

Fig. -1

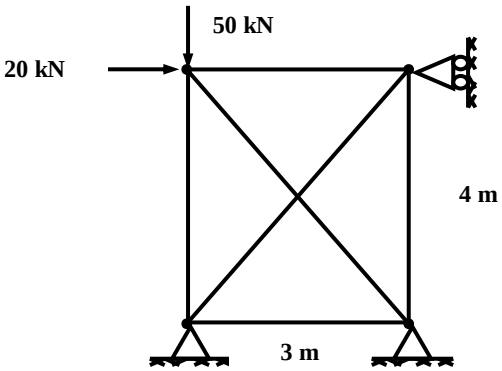

Fig. -2

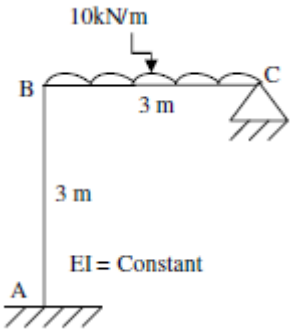

Fig. -3

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GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII • EXAMINATION – WINTER 2013

Subject Code: X70606 **Date: 10-12-2013**

Subject Name: Advanced Structural Analysis

Time: 10.30 am - 01.00 pm **Total Marks: 70**

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive Stiffness matrix for a plane frame with usual notations.	**07**
	(b)	Explain : [SMS], [R], {AC}, {AE}, [ARC], {AM}, [SRF]	**07**
Q.2	**(a)**	Write basic steps of F.E.M. and explain any one in detail.	**07**
	(b)	Explain use of Symmetry and Anti-symmetry in analysis of complex structures with suitable example.	**07**
		OR	
	(b)	Explain any two different loading facilities in the professional software.	**07**
Q.3	**(a)**	Enlist various secondary effects. Explain procedure to incorporate these effects in analysis.	**04**
	(b)	Analyse the beam as shown in **Figure-1** and draw SFD, BMD. Use Stiffness Member Approach.	**10**
		OR	
Q.3		Analyse the Plane frame shown in **Figure-2** using Stiffness Member Approach. Consider EI = EA for all members.	**14**
Q.4		Analyse the plane truss as shown in **Figure-3** using stiffness member approach. Calculate Member end actions. All members have same axial rigidity.	**14**
		OR	
Q.4		Analyse the Grid as shown in **Figure-4** below and draw SFD, BMD and TMD. Use Stiffness Member Approach. Consider EI = GJ = Constant.	**14**
Q.5	**(a)**	Derive Stiffness Matrix for two noded bar element using finite element method.	**07**
	(b)	For a bar element as shown in **Figure-5,** calculate nodal displacements and element stresses. Consider E = 200 GPa.	**07**
		OR	
Q.5	**(a)**	Derive Stiffness Matrix for two noded beam element using finite element method.	**07**
	(b)	Explain plane stress and plane strain problems with proper examples.	**07**

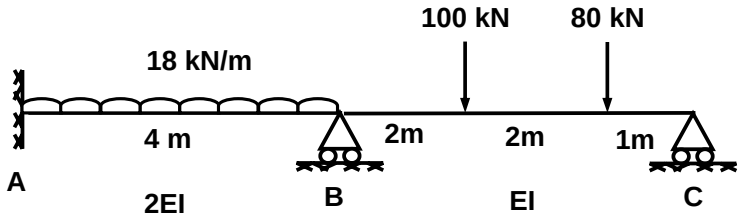

Fig. -1

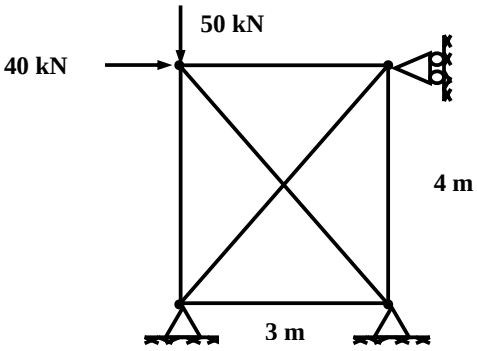

Fig. -3

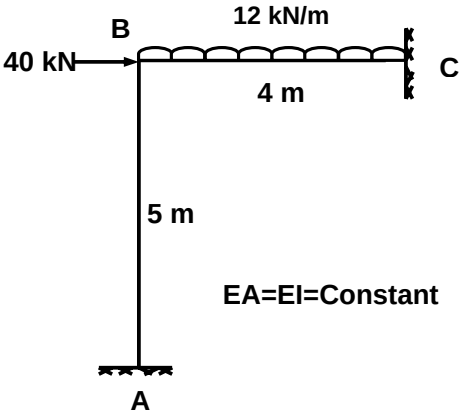

Fig. -2

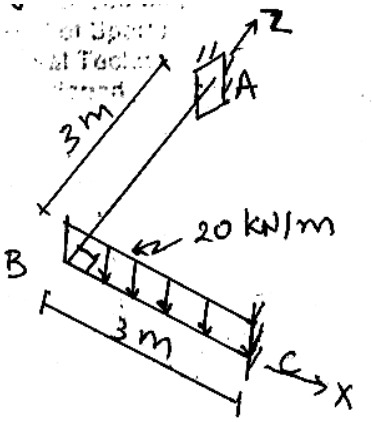

Fig. -4

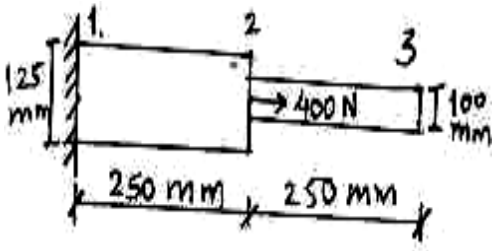

Fig. - 5

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Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

PDDC - SEMESTER–VII • EXAMINATION – SUMMER 2013

Subject Code: X-70606 Date: 20-05-2013

Subject Name: Advanced Structural Analysis

Time: 10.30 pm - 01.00 pm Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1	**(a)**	Derive Stiffness matrix for a beam with usual notations.	**07**
	(b)	Explain : [Sm], [RT], {AJ}, {AE}, [SFF], {AM}, [SRF]	**07**
Q.2	**(a)**	Explain advantages of Finite Element Method in detail.	**07**
	(b)	Write basic steps of F.E.M. and explain any two in detail.	**07**
		OR	
	(b)	Explain any two different loading facilities in the professional software.	**07**
Q.3	**(a)**	What are the advantages of Stiffness Member approach? Explain in detail.	**04**
	(b)	Analyse the beam as shown in **Figure-1** below and draw BMD. Use Stiffness Member Approach.	**10**
		OR	
Q.3		Analyse the beam as shown in **Figure-1** if Support B is sinking 10 mm in downward direction. Take E = 200 GPa and I = 200 x 10^6 mm^4.	**14**
Q.4	**(a)**	Derive Member stiffness Matrix for truss with usual notations.	**04**
	(b)	Analyse the plane truss as shown in **Figure-2** using stiffness member approach. Calculate Member end actions.	**10**
		OR	
Q.4		Analyse the Plane frame shown in **Figure-3** using Stiffness Member Approach.	**14**
Q.5	**(a)**	Derive Stiffness Matrix for two noded bar element using finite element method.	**07**
	(b)	Explain convergence criteria in detail also explain need of convergence.	**07**
		OR	
Q.5	**(a)**	Derive Stiffness Matrix for two noded beam element using finite element method.	**07**
	(b)	Explain convergence criteria in detail.	**07**