

GUJARAT TECHNOLOGICAL UNIVERSITY**M.E Sem-I Examination January 2010****Subject code: 711501 Subject Name: Matrix Analysis of Framed Structures****Date: 20 / 01 / 2010****Time: 12.00 – 3.00 pm****Total Marks: 60****Instructions:**

1. Attempt all questions.
2. Take $E = 200\text{GPa}$ & $EI = 20 \times 10^3 \text{ kNm}^2$, wherever not specified.
3. Make suitable assumptions wherever necessary.
4. Figures to the right indicate full marks.
5. Use member approach only except Q. 3, 2nd alternative and Q. 5, 2nd alternative.

- Q.1** (a) Attempt any two from the following: **06**
- (i) Explain any three terms from the following with illustration and specify whether it is pertaining to either flexibility method or stiffness method or both the methods, show the difference if pertaining to both the methods.
 $\{A_M\}$, $[S_{FR}]$, $\{A_Q\}$ & $\{A_J\}$
 - (ii) Write rotational transformation matrix $[R_T]$ for space frame.
 - (iii) A propped cantilever beam AB as shown in fig. 1 has a guided roller supported by a spring at B, calculate displacement of the spring.
 - (iv) For a beam shown in fig. 2, compute displacement/s.
- (b) If length of all the members of plane truss as shown in fig. 3 is 3 m and cross sectional area of members meeting at joint 2 is 300mm^2 while that for other two members is 150mm^2 , find displacements taking advantage of symmetry by stiffness method. **06**
- Q.2** The geometry of plane frame is as per fig.4(a) Consider $I = 10^{-3} \text{ m}^4$ and $I/A = 1/100 \text{ m}^2$. Out of four load cases as shown in fig. 4(a) to 4(d), construct load vectors $\{A_C\}$ for any two cases. **12**
- OR**
- Q.2** Compute displacements for a plane frame shown in fig.4(a) if $I = 10^{-3} \text{ m}^4$ and $I/A = 1/100 \text{ m}^2$. Can axial deformation be neglected in this frame? **12**
- Q.3** (i) Find displacement of plane grid shown in fig. 5 using stiffness method. Take self weight of 15kN/m and $GJ = 0.8EI$. Use symmetry of structure. **07**
- (ii) Also find either member end actions or reaction components. **05**
- OR**
- Q.3** A composite structure shown in fig. 6, consists of a beam ABC made up of hollow steel pipe having outer diameter of 200mm and thickness of 20mm with $E = 200\text{GPa}$, while BD and BE are 10mm diameter copper alloy wires with $E = 100\text{GPa}$. Compute displacements and member end actions using stiffness method, any approach. Advantage of symmetry may be availed. **12**
- Q.4** (i) For the beam shown in fig. 7 compute displacements using stiffness methods. **07**
- (ii) Also find either member end actions or reaction components. **05**
- OR**
- Q.4** (i) Find M_A & M_B and reactions for a beam shown in fig. 7, neglecting overhanging span CD, using flexibility method. **07**
- (ii) Also find either joint displacements or reactions. **05**

Q.5 Compute displacements and member end actions for space truss shown in **fig. 8**. 12
Axial rigidity of AD is 30MN while that for AB and AC is 20MN. Take advantage of symmetry. The co-ordinates are in m.

OR

Q.5 For the following cases, neglecting loading, explain secondary effects, using 12
appropriate matrix method.

- For **fig. 1**, at B end there is roller support which sinks by 12mm.
- For **fig. 2**, temperature above beam is 40°C and 15°C below the beam. Take $\alpha = 12 \times 10^{-6}/^{\circ}\text{C}$ and depth of beam as 300mm.
- For **fig. 3**, member 2 – 3 is short by 5mm.

