Instructions:

GUJARAT TECHNOLOGICAL UNIVERSITY

M. E. - SEMESTER – II • EXAMINATION – WINTER • 2013

Date: 24-12-2013

Subject Name: Finite Element Method Time: 10.30 am – 01.00 pm

Total Marks: 70

1. Attempt all questions.

Subject code: 1720801

- 2. Make suitable assumptions wherever necessary.
- 3. Figures to the right indicate full marks.
- Q-1aExplain the concept of FEM briefly and outline the procedure to solve the problem.7Q-1bWrite short note on Galerkin's method.7Q-2aExplain the term 'Axi-symmetric problems' and give constitutive law for it in FEM.7Q-2bExplain the procedure to derive the stiffness matrix for a beam element.7OROR0
- Q-2b Determine the shape functions for the Constant Strain Triangle (CST) with usual notations. 7
- Q-3a Determine the nodal displacements at node 2, stresses in each material and support reactions in 10 the bar shown in Fig. due to applied force $P = 400 \times 10^3 N$ and temperature rise of 30°C. Given: $A_1 = 2400 \text{ mm2} A_2 = 1200 \text{ mm}^2$, $l_1 = 300 \text{ mm}$, $l_2 = 400 \text{ mm}$, $E_1 = 0.7 \times 10^5 \text{ N/mm}^2 E_2 = 2 \times 10^5 \text{ N/mm}^2$ and $\alpha_1 = 22 \times 10^{-6} / \text{C}^\circ \alpha_2 = 12 \times 10^{-6} / \text{C}^\circ$



- Q-3b Explain properties of consistent mass and Lumped masses system in FEM.
- Q-3a Find the heat transfer per unit area through the composite wall shown in Fig. Assume onedimensional heat flow.

OR



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Q-4a Estimate the displacement vector, and stresses and for the truss structure as shown in fig.



Q-4b Explain the procedure to determine the stiffness matrix for truss element with temperature 4 gradients.

OR

Q-4a A beam of length 10 m, fixed at one end and supported by a roller at the other end carries a 20 10 kN concentrated load at the centre of the span. By taking the modulus of elasticity of material as 200 GPa and moment of inertia as 24×10^{-6} m⁴, Determine: 1. Deflection under load 2. Shear force and bending moment at mid span 3. Reactions at supports.



- Q-4b Explain the different types of non-linearity encountered in FEM structural analysis.
- Q-5a Find the natural frequencies of longitudinal vibrations of same stepped shaft of areas A and 2A 10 and of equal lengths (L), when it is constrained at one end, as shown in figure.



Q-5b Compare Finite Element Method, Finite Difference Method and Finite Volume Method. 4



Q-5a Find the temperature distribution in the one-dimensional fin shown in figure with 2 elements. 10



Q-5b Explain the term 'Eigen Value' and 'Eigen Vector' in FEM.

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