Code No. 6145 / M

FACULTY OF ENGINEERING

B.E. 3/4 (AE) II – Semester (Main) Examination, June 2014

Subject: Finite Element Analysis

Time: 3 Hours **Max.Marks: 75**

Note: Answer all questions from Part A. Answer any five questions from Part B.

PART – A

1 What are different types of mass matrices? Explain. (2)

2 Explain Gaussian quadrature for the evaluation of one dimensional integral. Why Gaussian Quadrature is necessary for finite element problems. (3)

3 How do you calculate capacitance [C] for unsteady state heat transfer problem? (2)

4 Derive material matrix for 2-D plane stress condition. (3)

5 Derive thermal load matrix for quadratic element. (2)

6 Write different type of boundary conditions associated with beam element. (2)

7 Obtain the strain displacement matrix [B] for one dimensional quadratic element at a point A which is at a distance of $\frac{3}{4}l^e$ from i^{th} node as shown in Fig. 1. (3)

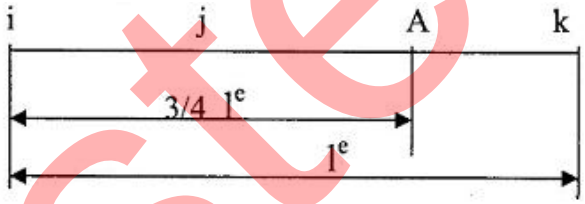

Fig.1

8 Express the thermal load vector for a truss member subjected to uniform temp change of ΔT in terms of E, A, α, and direction cosines 1 & m. E = 200 GPa, α = 20 x 10^{-6} per ^oC, $\Delta T = 60^oC$, l = 0.5, m = 0.866, A = 500 mm^2. (3)

9 Write stiffness matrix for frame element. (3)

10 Compare 2-D heat transfer problem with torsional analysis of a prismatic bar. (2)

PART – B

11 Calculate the nodal displacements and element stresses in the bar shown in Fig. 1. E = 200GPa; P=100 KN, α =20x10^{-6} per ^oC; ΔT=100^oC, A_1=1000mm^2, A_2 = 500mm^2

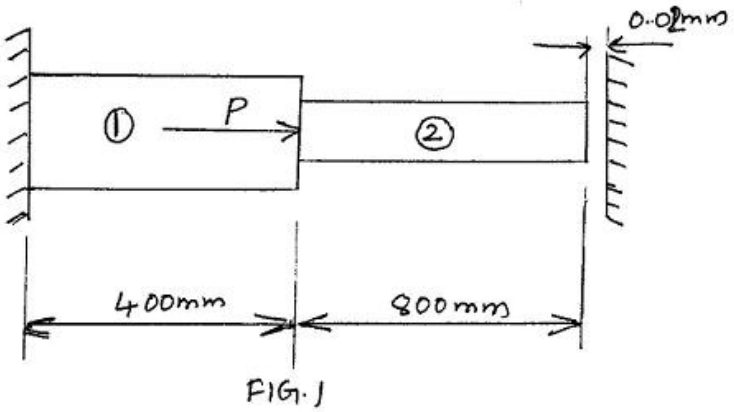

FIG. 1

…….2

12 Calculate nodal displacements and element elements for the members of the truss shown in Fig. 2. E=200GPa; A=500mm^2; P=50KN

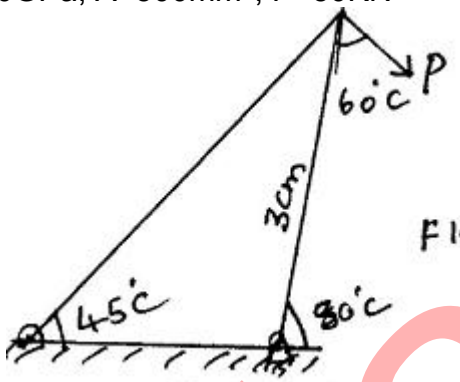

FIG. 2

13 A link of 2m is rotating at angular velocity 10rad/sec shown in Fig.3. Calculate nodal displacements and element stresses. Solve with 2 quadratic elements.
E=100GPa; l=2m; A=2x10^{-3}m^2; ρ =7850kg/m^3

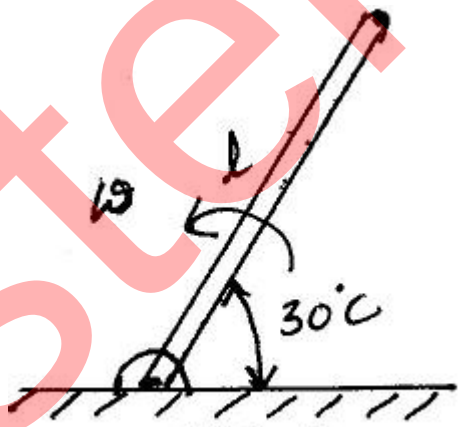

FIG. 3

14 Derive element force vector when linearly varying pressure acts on the side joining nodes ij of a triangular element shown in Fig.4 and body force of 50N/mm^3 acts downwards. Consider thickness of the element as 5mm. E=100GPa; P_i=10KN/mm^2; P_j=5KN/mm^2.

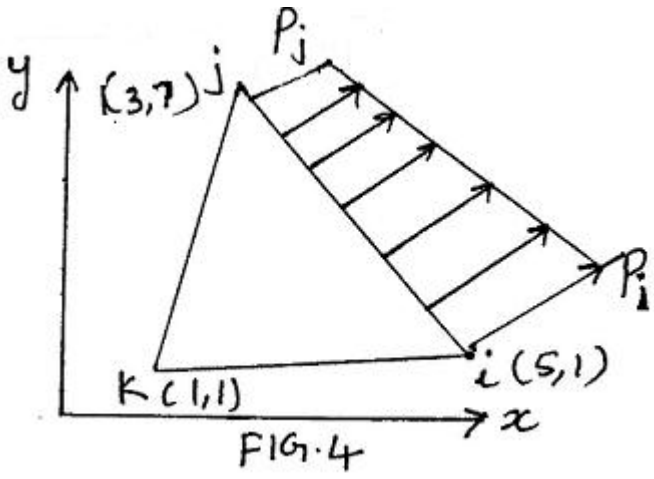

FIG. 4

15 (a) Derive shape functions for an 6-node triangular element.
(b) Determine Jacobian matrix at ξ=1/2 and η=1/2 for the following element.

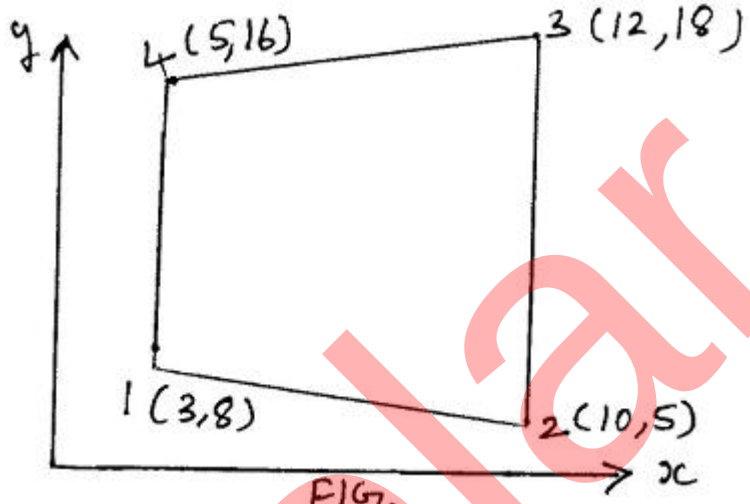

FIG.

16 Calculate the nodal temperatures using one-dimensional analysis of a fin given in Fig. 6. The fin has square cross-section. Assume that the tip of the fin is insulated. Solve the problem with 2-linear elements.

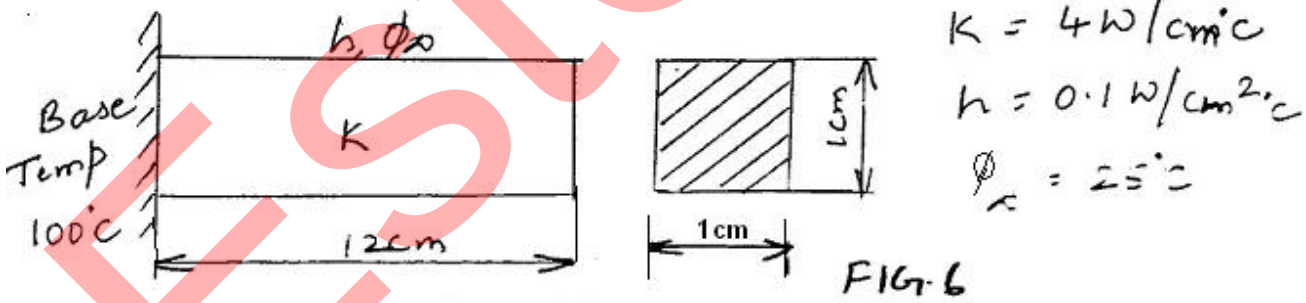

FIG. 6

17 For the stepped bar shown in Fig. 7, find natural frequencies in axial vibration and corresponding eigen vectors. E = 200GPa; L=300mm; A=600 mm^2; ρ =7500kg/m^3.

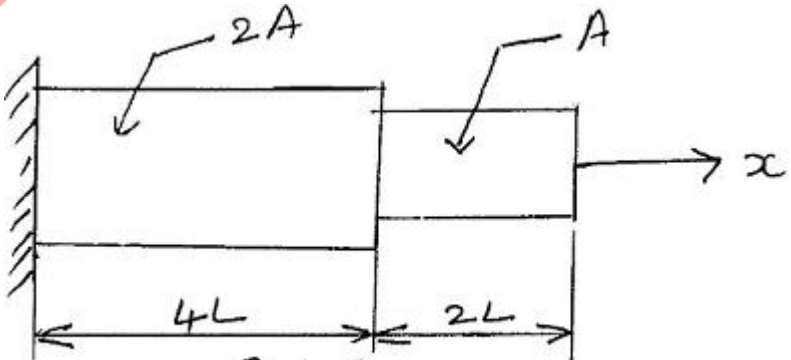

FIG. 7

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