Hall Ticket No | | | | | | | | | | |

Question Paper Code: AAE009

INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Four Year B.Tech V Semester End Examinations(Regular) - November, 2019

Regulation: IARE – R16

FINITE ELEMENT METHOD

Time: 3 Hours **(AE)** **Max Marks: 70**

Answer ONE Question from each Unit
All Questions Carry Equal Marks
All parts of the question must be answered in one place only

UNIT – I

1. (a) Derive constitutive matrix [D] for 2-D element. **[7M]**

   (b) Consider the bar as shown in Figure 1. Calculate the following
   i) Nodal displacements
   ii) Element stresses
   iii) Support reactions. Take E=2×10^5 N/mm^2 ; P=400 kN **[7M]**

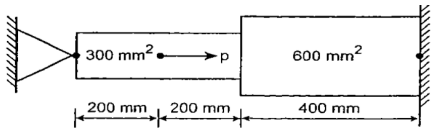

Figure 1

2. (a) When there are several FEM packages available in the market is there need to study this subject. Why? State the applications of FEM. **[7M]**

   (b) Consider the following Figure 2. An axial load P=200 KN is applied as shown i) Determine the nodal displacements. ii) Determine the stress in each material. iii) Determine the reaction forces. **[7M]**

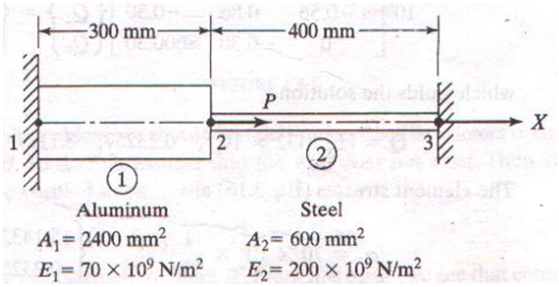

Figure 2

UNIT – II

3. (a) Obtain the stiffness matrix for a beam element. **[7M]**

   (b) For the two-bar truss shown in Figure 3, determine the displacement in the y direction of node 1. A force of P = 1000 kN is applied at node 1 in the positive y direction. Let E = 210 GPa and A = 6 x 10^{-4} m^2 for each element. **[7M]**

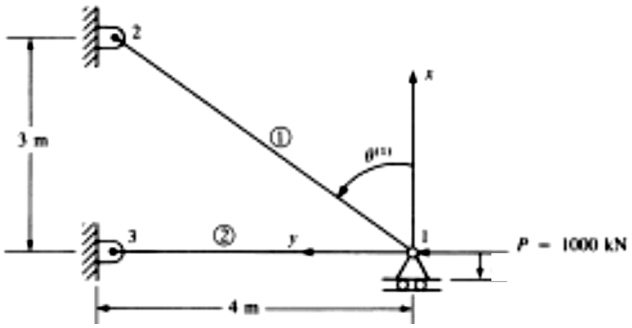

Figure 3

4. (a) Derive elemental stiffness matrix for 2-noded truss elements. **[7M]**

   (b) Find the deflection at the point load and the slopes at the ends for the steel shaft which is simply supported at the bearing A and B as shown in Figure 4. Take E=200GPa. **[7M]**

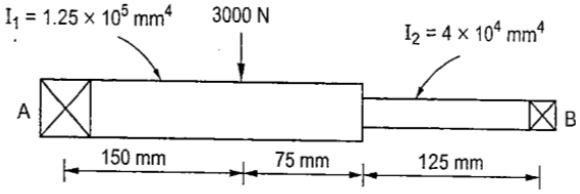

Figure 4

UNIT – III

5. (a) Derive the shape function for CST element. **[7M]**

   (b) Apply the element stiffness matrix for the triangular element shown in Figure 5 under plane strain condition. Assume the following values. E=200 GPa, μ=0.25, t=1 mm. **[7M]**

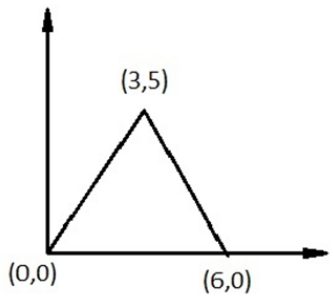

Figure 5

6. (a) Derive stiffness equation for a constant strain triangular element. **[7M]**

   (b) For the point P located inside the triangle in Figure 6, the shape functions N1 and N2 are 0.15 and 0.25, respectively. Determine the x and y coordinate of P. **[7M]**

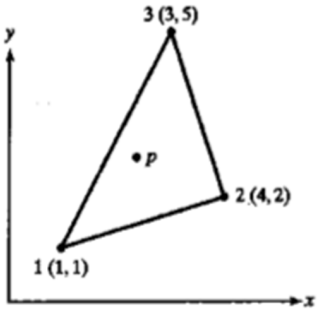

Figure 6

UNIT – IV

7. (a) Derive Stiffness matrix and load vector for heat transfer in2-D element. **[7M]**

   (b) Determine the nodal temperature in a composite wall, the wall is maintained at 100 deg c at the left face and convection mode of heat transfer occurs between the right face and existing fluid .take k1=0.06w/cm deg c and k2=0.2w/cm deg c, convection co efficient of heat transfer between walls and fluid h=0.1w/cm^2 ^{0}C and T =25^{0}C. Consider unit area=1 cm^2 perpendicular to the direction of heat flow. **[7M]**

8. (a) Deduce shape functions for temperature element. **[7M]**

   (b) Compute the element matrix and vectors for the element shown in Figure 7, when the edges 2-3 and 3-1 experience convection heat loss. **[7M]**

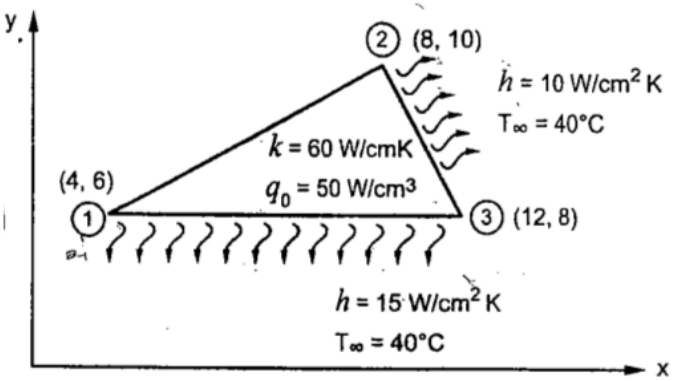

Figure 7

UNIT – V

9. (a) Derive lumped mass matrix and consistent mass matrix for a bar element. **[7M]**

   (b) Explain Lumped parameter model and Continuous system model with examples. **[7M]**

10. (a) Find the natural frequencies and mode shapes of a uniform cantilever beam using one beam element and consistent mass matrix. **[7M]**

(b) Determine the Eigen values and Eigen vectors for the stepped bar shown in Figure 8. **[7M]**

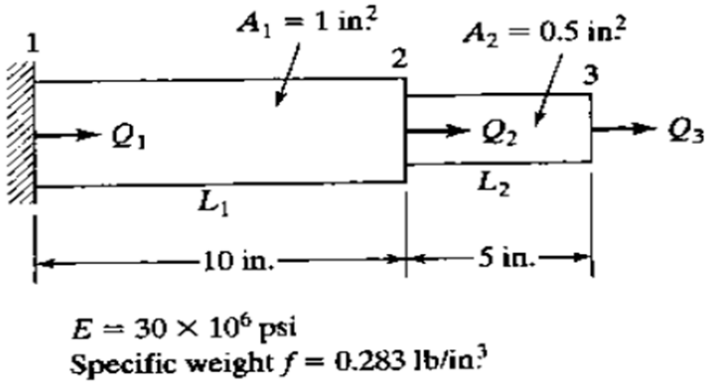

Figure 8