Sixth Semester B.E. Degree Examination, June/July 2016 Finite Element Analysis

Time: 3 hrs.

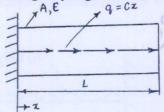
Max. Marks: 100

Note: Answer FIVE full questions, selecting at least TWO questions from each part.

PART - A

- 1 a. State the principle of minimum potential energy. Derive an expression for total potential energy for a 3-D elastic body subjected to body force, traction and point load. (10 Marks)
 - b. A bar of length L, cross sectional area A and modulus of elasticity E, is subjected to distributed axial load q = cx, where c is a constant as shown in Fig.Q.1(b). Determine the displacement of the bar at the end using Rayleigh-Ritz method. (10 Marks)

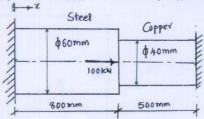
Fig.Q.1(b)



- 2 a. What are convergence requirements? Discuss the three conditions of convergence requirements. Also define confirming (compatible) and non-confirming elements. (10 Marks)
 - b. Derive the shape functions for 1-D bar element in natural coordinate and also show the variation.

 (10 Marks)
- 3 a. Derive the elemental stiffness matrix for a 2-D truss element. (10 Marks)
 - b. Determine the nodal displacement, stress in each element and the support reaction in the stepped bar shown in Fig.Q.3(b). Take $E_{steel} = 200$ GPa, $E_{cu} = 100$ GPa. (10 Marks)

Fig.Q.3(b)

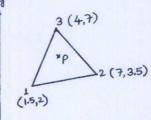


4 a. Differentiate between CST and LST elements.

(06 Marks)

b. For the triangular element shown in Fig.Q.4(b). Determine the Jacobian matrix and also the shape functions at the point P(3.85, 4.8). (08 Marks)

Fig.Q.4(b)



Write a short note on Geometrical Isotropy for 2-D Pascal triangle.

(06 Marks)

PART - B

- 5 a. Derive the shape function for 4-noded tetrahedral elements. (10 Marks)
 - b. Differentiate between Lagrange and serendipity family of elements, with neat sketches.

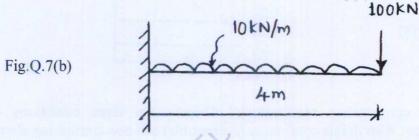
(10 Marks)

- What are iso-parametric, sub-parametric and super parametric elements? Explain with neat 6 sketches.
 - b. Explain the three phases in finite element analysis.

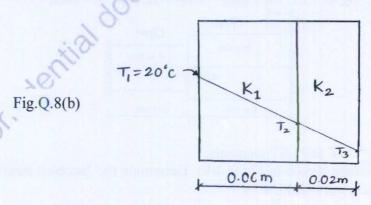
(06 Marks) (05 Marks)

List the 10-software packages used in FEA.

- What are Axisymmetric elements? Explain the axisymmetric triangular element, with neat 7 sketch.
 - b. Determine the maximum deflection in the uniform cross-section of the cantilever beam shown in Fig.Q.7(b) by assuming the beam as a single element. Take $E = 7 \times 10^9 Pa$, $I = 4 \times 10^{-4} \text{m}^4$. (10 Marks)



- Derive an expression for the thermal conductivity matrix for 1-D two noded heat element.
 - b. Determine the temperature distribution through the composite wall subjected to convection heat loss on the right side surface with convective heat transfer coefficient as shown in Fig.Q.8(b). The ambient temperature is -5°C. (12 Marks)



h, T_{∞} } $K_{1} = 6W/m^{\circ}C$ $K_{2} = 20W/m^{\circ}C$ $K_{3} = 1000W/m^{\circ}C$ To = -5°C