Eighth Semester B.E. Degree Examination, June/July 2017
Finite Element Analysis

Time: 3 hrs.   Max. Marks:100

*Note: **Answer any FIVE full questions, selecting**
atleast TWO questions from each part.*

PART – A

1   a.   Indicate state of stress and strain at a point interms of $\{\sigma\}$ and $\{\in\}$. Mention its practical importance.   **(05 Marks)**
    b.   How potential energy functions are classified as stable/unstable/neutral? Give examples.   **(08 Marks)**
    c.   Obtain stiffness relation(K) with nodal force(F) and nodal displacement(Q) using energy principles.   **(07 Marks)**

2   a.   Mention the steps followed in Galenkin's method while finding displacement of a cantilever beam.   **(08 Marks)**
    b.   Using Rayleigh-Ritz method, derive an equation for maximum deflection for a simply supported beam at the center using Trignometric function.   **(12 Marks)**

3   a.   What are displacement functions? Mention its types. Which one of them is widely used and why?   **(08 Marks)**
    b.   Obtain the expression of variation of shape functions for one dimensional bar element interms of :
      i) L_1 and L_2 ii) x_1 and x_2.   **(12 Marks)**

4   a.   Obtain the relation between nodal displacement of truss element in local and global coordinates.   **(04 Marks)**
    b.   Determine nodal displacements and forces for the truss (two bar) shown in Fig.4(b).

Fig.Q4(b)

Assume $q_2 = 50 \times 10^{-3}$ mm at node (i) roller support no nodal displacements at hinge support.   **(16 Marks)**

PART – B

5 a. Obtain strain-displacement matrix for 4 noded 2 dimensional rectangular element assuming 2DOF at each node. Consider natural coordinates. **(10 Marks)**

   b. Obtain strain-displacement matrix and strains $\in_x$, $\in_y$ and γ_{xy} for the element shown in Fig.Q5(b). Assume nodal displacements vector $\{q\} = \{2, 1, 1, -4, -3, 7\} \times 10^{-2}$ mm. **(10 Marks)**
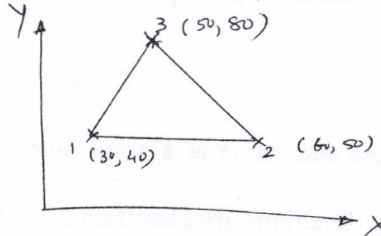

Fig.Q5(b)

6 Obtain shape functions for the following elements using Lagrange interpolation function and sketch the variation, shown in Fig.Q6. **(20 Marks)**

Fig.Q6(i)

Fig.Q6(ii)
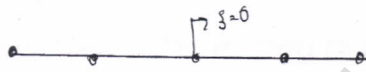
Fig.Q6(iii)
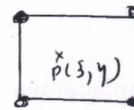
Fig.Q6(iv)

7 a. What are isoperimetric elements? Distinguish super from sub parametric elements with sketches. **(08 Marks)**

   b. Convert the following parent elements shown in Fig.Q7 to global Cartesian coordinate system having arbitrary curved/surfaces. No equations be derived. Only sketch the transformed shapes. **(12 Marks)**
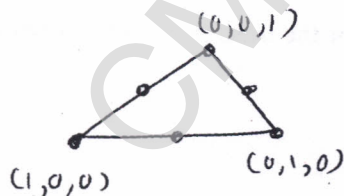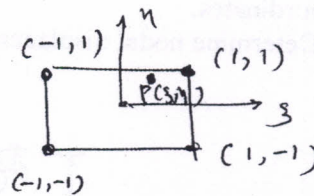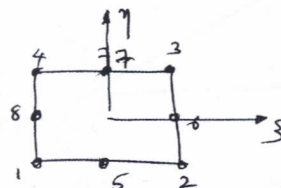

Fig. Q7(b)(i)

Fig.Q7(b)(ii)
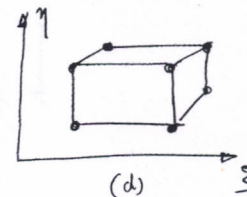

Fig.Q7(b(iii)

Fig.Q7(iv)

8 Write note on :
   a. Numbering of nodes
   b. Patch test
   c. Softwares used in FEM
   d. Constitutive law. **(20 Marks)**

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