USN | | | | | | | | | | |

10AE64

Sixth Semester B.E. Degree Examination, Dec.2018/Jan.2019
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. Determine the displacements of nodes of the spring system shown in Fig Q1(a).

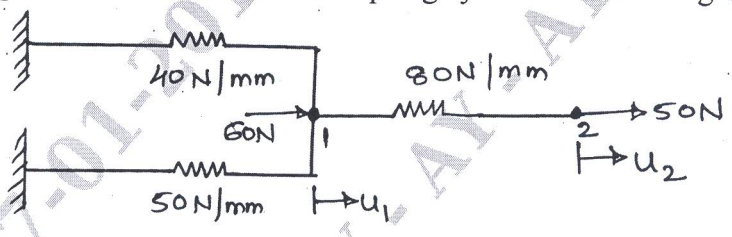


Fig Q1(a) **(06 Marks)**

b. Using Rayleigh – Ritz method, determine the expression for displacement in a fixed bar subjected to axial force 'P' as shown in Fig Q1(b). Assume 2nd order polynomial displacement function.

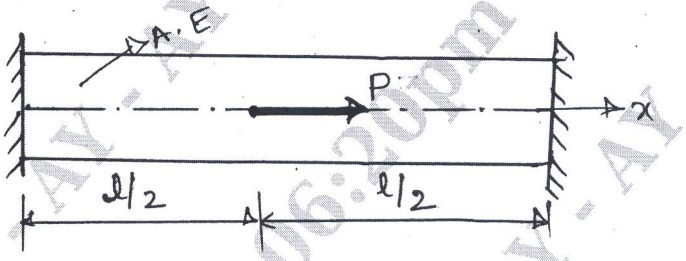


Fig Q1(b) **(08 Marks)**

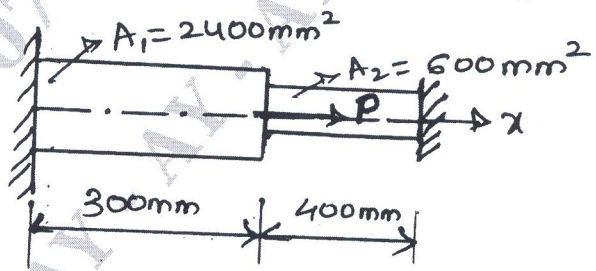
c. Explain simplex, complex and Multiplex elements in Finite Element Method. **(06 Marks)**

2 a. Derive the shape function for a 2 noded bar element using Natural co-ordinate system. Also shown the variation of shape function. **(08 Marks)**

b. Explain convergence criteria and its requirements. **(06 Marks)**

c. Explain Global, Natural and local co-ordinate system used in FEM. **(06 Marks)**

3 a. An axial load $P = 200 \times 10^3$N is applied for the bar as shown in Fig Q 3(a). Determine the nodal displacements and stress in each material using Penalty approach method. **(08 Marks)**



$E_1 = 70 \times 10^9$ N/m^2
$E_2 = 200 \times 10^9$ N/m^2

Fig Q3(a)

b. Write the stiffness matrix for the following elements along with sketches of elements
   i) Bar element
   ii) Beam element
   iii) Truss element. **(06 Marks)**

c. What are Boundary conditions and explain the following methods to take care of boundary conditions:
   i) Elimination method
   ii) Penalty method. **(06 Marks)**

4 a. Derive the shape function for 8 noded rectangular elements. Using natural coordinates. **(10 Marks)**

b. Evaluate the shape functions N_1, N_2 and N_3at the interior point 'P' for the triangular element shown in Fig Q4(b).

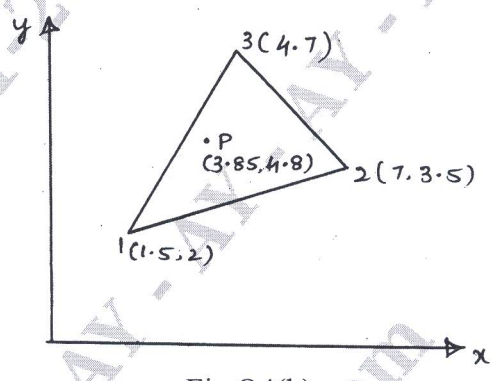


Fig Q4(b) **(06 Marks)**

c. Explain CST and LST elements. **(04 Marks)**

PART – B

5 a. Derive shape function for a 8 – noded hexahedral element. **(12 Marks)**

b. What are Lagrangian and serendipity family of elements and explain. **(08 Marks)**

6 a. Explain iso-parametric, sub parametric and super parametric elements with suitable sketch. **(10 Marks)**

b. Explain pre-processing, processing and post processing used in FEM software. **(10 Marks)**

7 a. What are axisymmetric elements and explain axisymmetric triangular elements finite element modelling. **(07 Marks)**

b. Prove that area of axi-symmetric triangular element
$A_e = \frac{1}{2} | d_{et} J |$ **(07 Marks)**

c. Obtain the expression for stiffness matrix of an axisymmetric rectangular element. **(06 Marks)**

8 a. Derive the expression for stiffness matrix of 1 – D Heat conduction. **(08 Marks)**

b. Determine the temperature distribution in the rectangular fin shown in Fig Q8(b). Neglect convection heat transfer and assume heat generated inside the fin as 500 W/m^3.

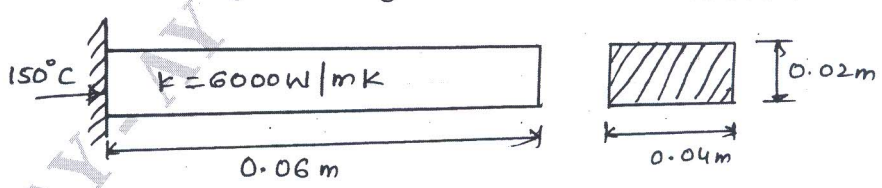


Fig Q8(b) **(12 Marks)**

* * * * *