Registration No. : | | | | | | | | | | |

Total number of printed pages – 3

B. Tech

FEME 6301

Sixth Semester Regular Examination – 2015

FINITE ELEMENT METHOD

BRANCH : MECH

QUESTION CODE : J 440

Full Marks – 70

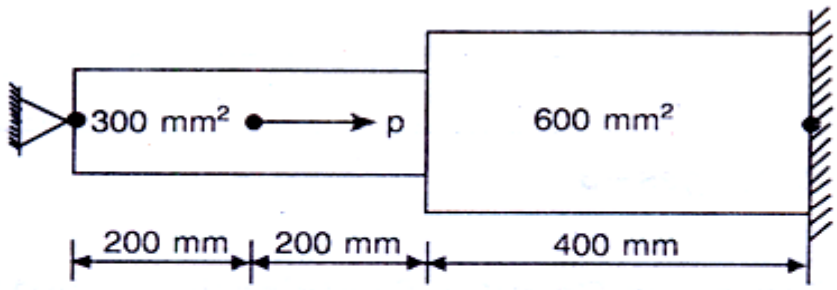
Time : 3 Hours

*Answer Question No. **1** which is compulsory and any **five** from the rest.*

The figures in the right-hand margin indicate marks.

1. Answer the following questions : 2×10
   (a) During discretization, mention the places where it is necessary to place a node ?
   (b) State the principle of minimum potential energy.
   (c) What do you mean by constitutive law ?
   (d) Why polynomial types of interpolation functions are mostly used in FEM ?
   (e) What is meant by degrees of freedom ?
   (f) What are the types of loading acting on the structure ?
   (g) Write down the expression of stiffness matrix for a truss element.
   (h) Write down the stiffness matrix equation for one dimensional heat conduction element.
   (i) Write the post processing steps for FEM.
   (j) Name two FEA softwares.
2. (a) Describe the general steps of the finite element method. 5
   (b) Derive the strain displacement matrix for a 2-noded one dimensional bar element. 5
3. Consider the bar as shown in figure below. Calculate the following : 10
   (i) Nodal displacements
   (ii) Element stresses
   (iii) Support reactions.

P.T.O.



Take E = 2 x 105 N/mm² ; P = 400 kN.

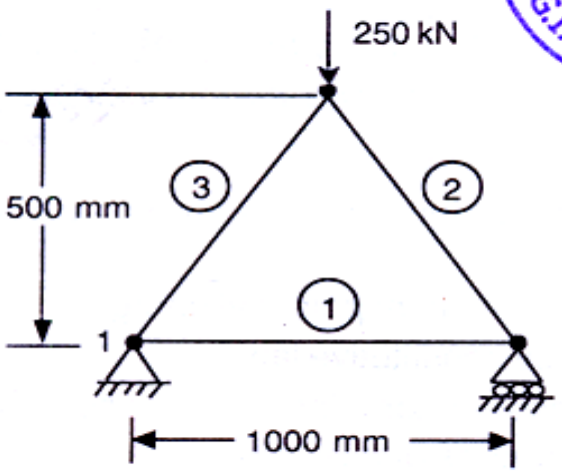
4. Consider a three bar truss as shown in figure below. It is given that $E = 2 \times 10^5$ N/mm². Calculate the following : 10

(i) Nodal displacements

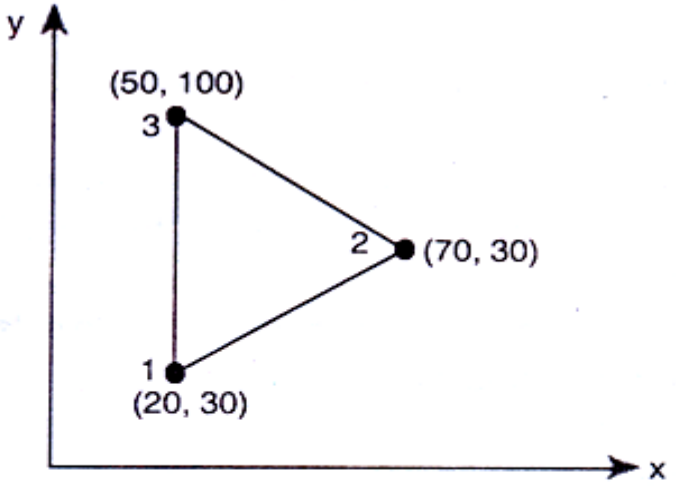
(ii) Stress in each member

(iii) Reactions at the support

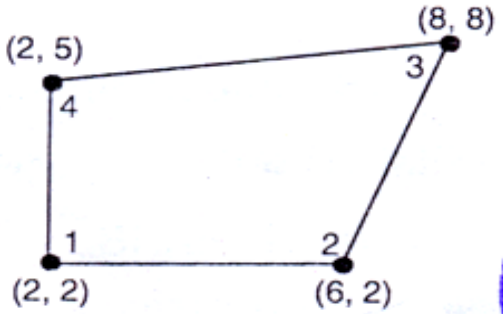
Take Area of element 1, 2 and 3 are 2000 mm², 2500 mm² and 2500 mm² respectively



5. Assemble the Strain-Displacement matrix for the CST element shown in figure below. Take, t = 25 mm and E = 210 GPa. The co-ordinates are shown in units of millimeters. 10



6. (a) For the isoparametric four noded quadrilateral element shown in figure below, determine the cartesian co-ordinates of point P which has local co-ordinates $\xi = 0.25$ and $\eta = 0.25$. 5



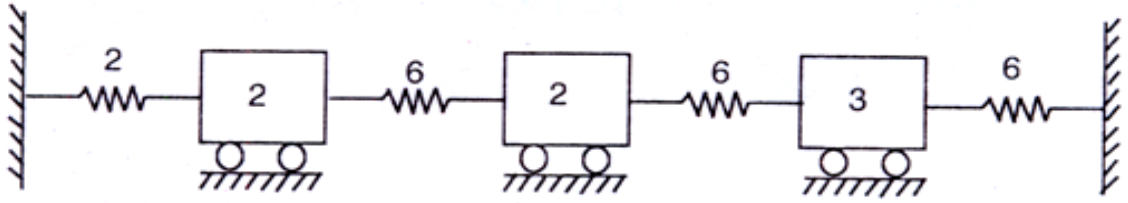
(b) The nodal co-ordinates for an axisymmetric triangular element are given below :

$r_1 = 15$ mm, $z_1 = 15$ mm; $r_2 = 25$ mm, $z_2 = 15$ mm; $r_3 = 35$ mm, $z_3 = 50$ mm.

Determine [B] matrix for that element. 5

7. (a) Derive the stiffness matrix for one dimensional heat conduction element. 5

(b) Give the FE modeling for vibration of the system given in figure below : 5



8. Write short notes on any **two** : 5×2

(a) The applications of FEM.

(b) The basic steps involved in FEM.

(c) Variational Methods.

(d) Constant Strain Triangle elements.