Registration no: | | | | | | | | | | |

Total Number of Pages: 3 **B.Tech**
FEME6301

6th Semester Regular / Back Examination 2015-16
FINITE ELEMENT METHOD
BRANCH: AUTO, MANUFAC, MANUTECH, MECH
Time: 3 Hours
Max Marks: 70
Q.CODE: W527

Answer Question No.1 which is compulsory and any five from the rest.
The figures in the right hand margin indicate marks.

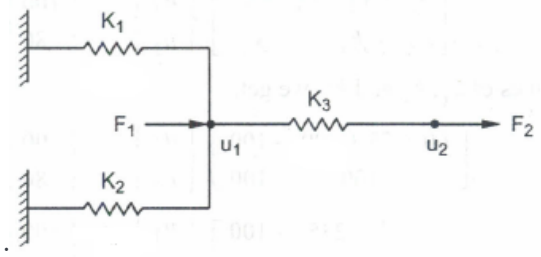
Q1 Answer the following questions: **(2 x 10)**

a) State the necessary location of nodes during discretization process?
b) What is Rayleigh-Ritz method?
c) How frame structure is different from bars?
d) State the characteristics of shape functions ?
e) What is the importance of Pascal's triangle in FE analysis?
f) What isoparametric elements signify?
g) What are the necessary conditions for a problem to be axisymmetric?
h) Which non-structural problems can be solved using FEM?
i) Write down the stiffness matrix equation for one dimensional heat conduction element.
j) List the commercial FE codes available for finite element analysis.

Q2 **a)** Briefly describe the general steps of the finite element method. **(5)**

b) Determine the displacements of nodes 1 and 2 in the spring system shown in figure below. Use minimum of potential energy principle to assemble equations of equilibrium. **(5)**

Given $K_1 = 60$ N/m, $K_2 = 75$ N/m, $K_3 = 100$ N/m,
$F_1 = 100$ N, and $F_2 = 80$ N/m.



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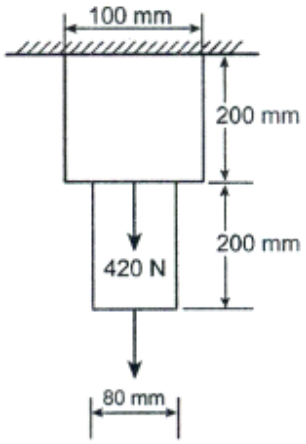
Q3 A thin steel plate of uniform thickness 25 mm is subjected to a point load of 420 N at mid depth as shown in side figure. The plate is also subjected to self-weight. If Young's modulus, $E = 2 \times 10^5$ N/mm^2 and unit weight density, $\rho = 0.8 \times 10^{-4}$ N/mm^3, calculate the following: **(10)**

(i) Displacement at each nodal point.

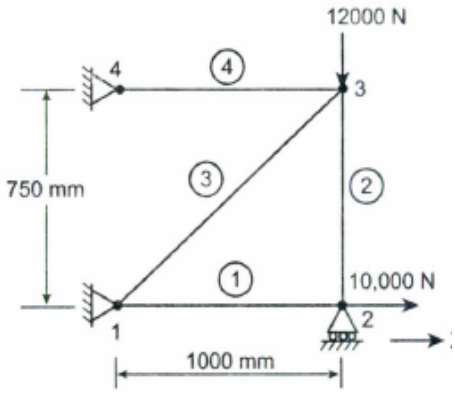
(ii) Stresses in each element.



Q4 a) Consider a four bar truss as shown in figure at side. It is given that $E = 2 \times 10^5$ N/mm^2 and $A_e = 625$ mm^2 for all elements. **(6)**

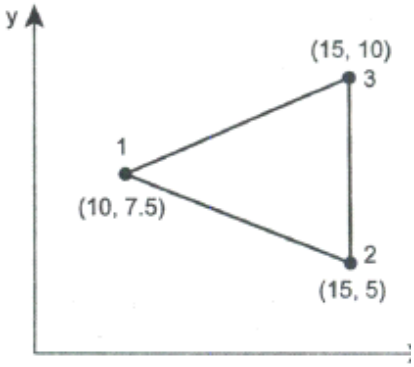
(i) Determine the element stiffness matrix for each element.

(ii) Assemble the structural stiffness matrix K for the entire truss.



b) The Cartesian coordinates of the corner nodes 1, 2 and 3 of a triangular element are given by (1,3),(4,2) and (3,5) respectively. Determine the shape functions N_1 , N_2 and N_3 at a interior point P (2,4). **(4)**

Q5 a) Calculate the stiffness matrix for the elements shown in figure below. Assume plane stress conditions. Take,poison's ratio= 0.25, t = 10 mm and E = 210 GPa. The co-ordinates are shown in units of millimeters. **(10)**

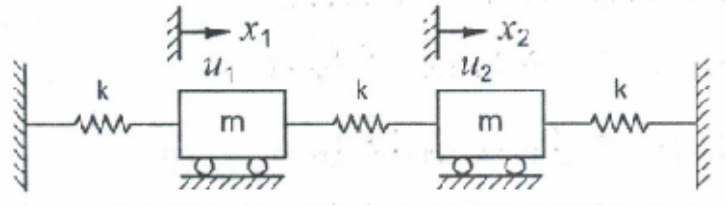


Q6 a) From basics derive the shape functions and strain-displacement matrix for axisymmetric element with constant strain triangular elements **(5)**

b) The Cartesian coordinates of the corner nodes of an isoparametric quadrilateral element are given by (1,0),(3,0),(4,3) and (2,1). Find its Jacobian matrix. **(5)**

Q7 **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)**



Q8 Write short notes on any two : **(5 x 2)**

a) Galerkin method

b) Minimum potential energy principle

c) Advantages and disadvantages of FEM

d) Subparametric and Superparametric elements