PVP 14

Code: ME7T3

IV B.Tech - I Semester – Regular/Supplementary Examinations
March - 2021

FINITE ELEMENT METHODS
(MECHANICAL ENGINEERING)

Duration: 3 hours Max. Marks: 70

PART – A

Answer ***all*** the questions. All questions carry equal marks

11 x 2 = 22 M

1.

a) Write the material property matrix for 3-D problems.
b) What are plane stress and plane strain conditions?
c) Differentiate between local and global coordinates?
d) What are the different types of boundary conditions? Give examples.
e) Write the transformation matrix from local coordinates to global coordinates for a truss element?
f) Explain the Hermite Shape Functions.
g) Write the shape functions for four nodded Quadrilateral element.
h) Specify the strain displacement matrix of CST element and comment on it.
i) What do you mean by axisymmetric problem? List commonly used axisymmetric elements.
j) Write down the governing differential equation for the steady state one dimensional conduction heat transfer.
k) Explain the principle of finite element method.

PART – B

Answer any ***THREE*** questions. All questions carry equal marks.

3 x 16 = 48 M

2. a) Derive the various equations of static equilibrium of an elastic body. 6 M

b) If a displacement field is described by 10 M

$u = (-x^2 + 2y^2 + 6xyz + 2z^2 + 4yz)\ 10^{-4}$

$v = (3x + 6y - y^2 + 6yz + 3z)\ 10^{-4}$

$w = (x^2 + 2y^2 + z^2 - 2z + 2xyz)\ 10^{-4}$

Determine the strain field at the point x = 1 and y =0.

3. The stepped bar shown in Figure-1 is subjected to an axial load P=200 KN. Determine the nodal displacements, elemental stresses and support reactions. 16 M

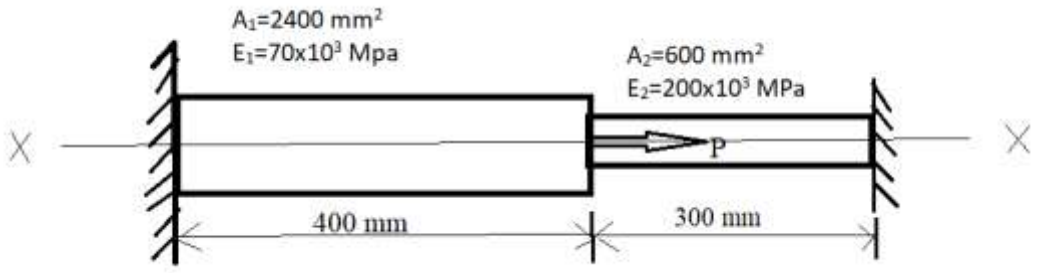

Figure-1

4. a) Derive an expression for the stiffness matrix for 2D truss element. 6 M

b) For the beam shown in Figure-2, determine the deflection under the load P. E = 200 GPa, I= 25 x 10^4 mm^4 . 10 M

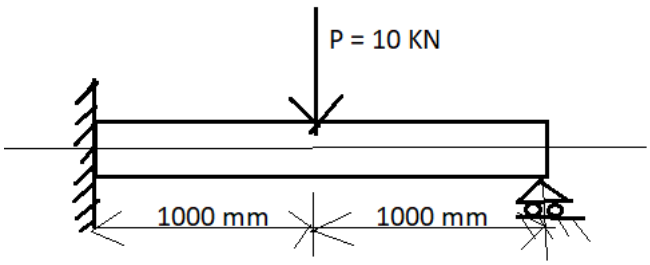

Figure-2

5. a) The nodal coordinates for the CST element are (1,1) (4,2) (3,5) and the shape functions N_1=0.15, N_2=0.25. Determine the x, y coordinates of any interior point P. 10 M

b) Explain the concept of isoparametric, sub parametric and super parametric elements. 6 M

6. a) Derive the stress-strain relationship matrix (D) for the axisymmetric triangular element. 6 M

b) A furnace wall is made up of three layers, inside layer with thermal conductivity 7.5 W/m ^{0}K, the middle layer with conductivity 0.35 W/m ^{0}K, the outer layer with conductivity 0.09 W/m ^{0}K. The respective thicknesses of the inner, middle and outer layer are 3.5 cm, 6 cm and 4 cm respectively. The inside temperature of the wall is 600 ^{0}K and outside of the wall is exposed to atmospheric air at 28 ^{0}K with heat transfer coefficient of 45 W/m^2 ^{0}K. Determine the nodal temperatures. 10 M