Total No. of Questions : 10]

SEAT No. :

P3062

[Total No. of Pages : 4

[5354] - 550-A

B.E. Mechanical (Semester - II)

FINITE ELEMENT ANALYSIS (Elective - IV)

(2012 Pattern)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates:

1) *Figures to the right indicate full marks.*
2) *Use of electronic pocket calculator is allowed.*
3) *Assume suitable data, if necessary.*

Q1) a) Write down different applications of FEA and explain procedure for FEA analysis of stress analysis **[6]**

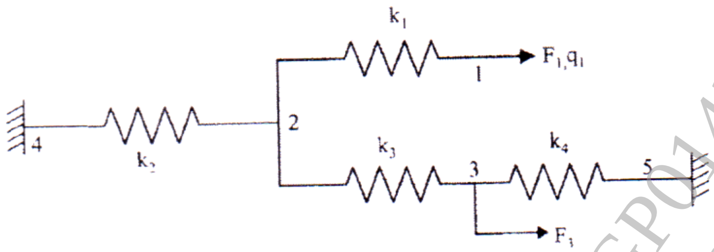
b) Write down difference between penalty and elimination approach for FEA solution **[4]**

OR

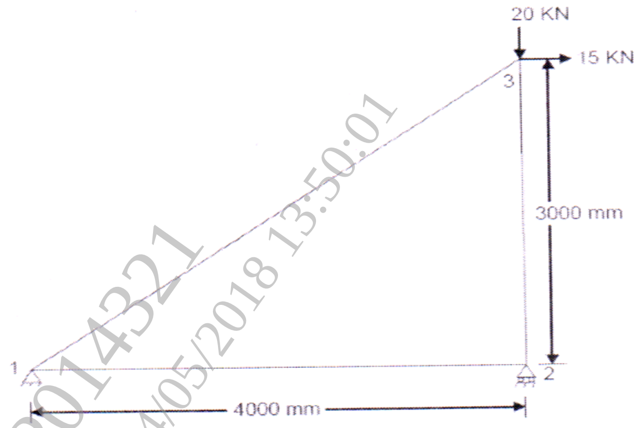
Q2) a) Explain "Releigh Ritz Method" to formulate FEM equations. **[6]**

b) Explain Plane stress and Plane Strain **[4]**

Q3) a) Calculate Nodal displacement of spring system shown in figure **[4]**

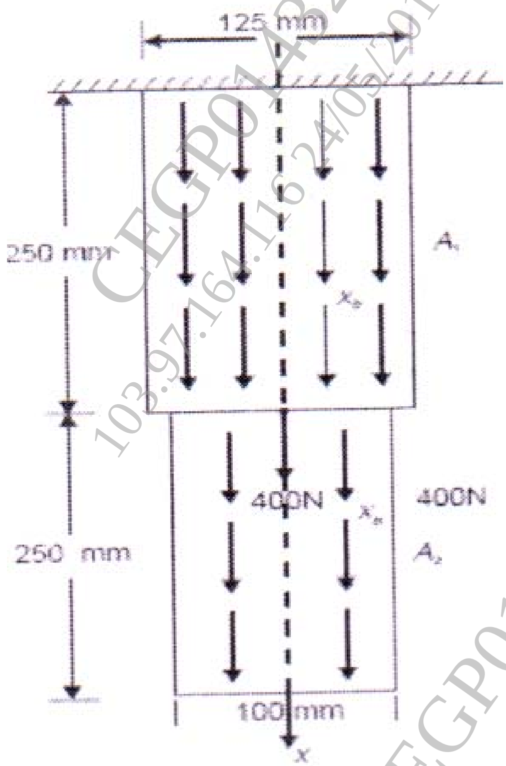


b) Obtain the forces in the plane truss shown in Fig. and determine the support reactions also. Use finite element method. Take E= 200 GPa and A = 2000 mm^2 **[6]**

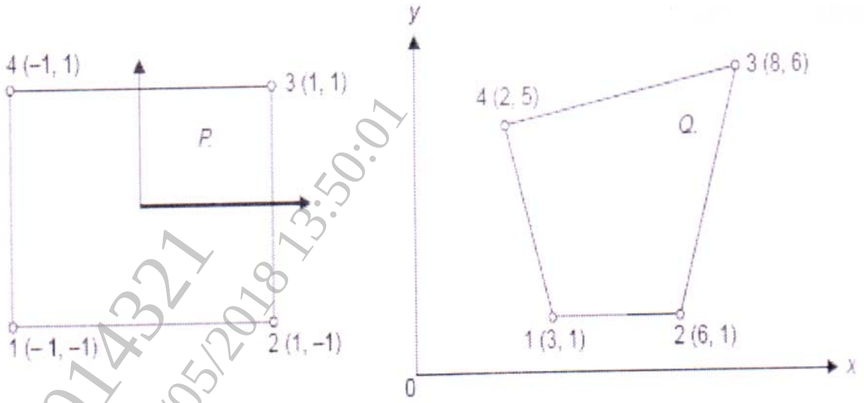


OR

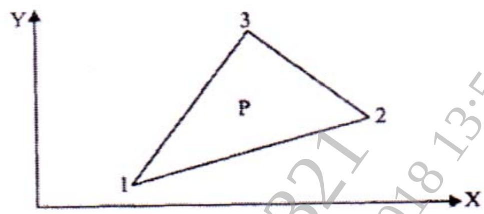
Q4) The thin plate of uniform thickness 20 mm, is as shown in Fig. In addition to the self-weight, the plate is subjected to a point load of 400N at mid- depth. The Young's modulus $E = 2 \times 10^5$ N/mm^2 and unit weight $\rho=0.8\times10^{-4}$N/mm^2. Analyse the plate after modelling it with two elements and find the stresses in each element. Determine the support reactions also. **[10]**



Q5) a) For the iso-parametric quadrilateral elements shown in Fig., determine Local coordinates of the point Q which has Cartesian coordinates (7, 4) **[8]**



b) For a point P located inside the triangle shown in figure, the shape functions N_1 and N_2 are 0.15 and 0.25 respectively. Determine the x and y coordinates of point P. **[10]**



OR

Q6) a) What is fill and reduced integration in Finite Element Analysis? **[4]**

b) Write a short note on Patch Test **[4]**

c) Evaluate $I = \left(\int_{y=-2}^{y=2} \int_{x=-1}^{x=1} (x^2 + 2xy + y^2)\, dx\, dy \right)$ using Gauss Quadrature method **[10]**

Q7) a) Derive elemental stiffness matrix (conduction + convection) formulations for 1 D steady state heat transfer problems. **[8]**

b) Consider a brick wall of thickness 0.3 m, k = 0.7 W/m °K. The inner surface is at 28°C and the outer surface is exposed to cold air at -15°C. The heat transfer coefficient associated with the outside surface is 40 W/m² °K. Determine the steady state temperature distribution within the wall and also the heat flux through the wall. Use two elements and obtain the solution. **[8]**

OR

Q8) a) Heat is generated in a large plate (K = 0.4 W/m 0 c) at the rate of 5000 W/m^3 The plate is 20 cm thick. Outside surface of the plate is exposed to ambient air at 30°C with a convective heat transfer coefficient of 20 $W/m^{20}c$. Determine the temperature distribution in the wall. **[6]**

b) A metallic fin, with thermal conductivity 360 W/m °K, 0.1 cm thick and 10 cm long extends from a plane wall whose temperature is 235°C. Determine the temperature distribution along the fin if heat is transferred to ambient air at 20°C with heat transfer coefficient of 9 W/m20K. Take width of the fin as 1m. **[6]**

Q9) a) Determine a three Natural frequencies of bar having following specifications Length of bar = 1 m Diameter of bar = 10mm E = 2×10^5 N/mm^2 density ρ = 7800 kg/m^3 and also validate the first natural frequency of FEA results with theoretical frequency which can be determined by

$$\omega_n = \sqrt{\frac{K}{M}}\ rad/s$$ **[16]**

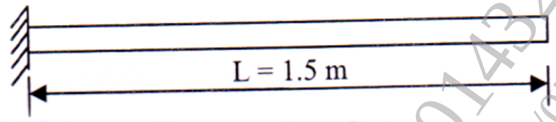
OR

Q10) a) Write a Lumped & Consistent Mass and stiffness matrix for **[4]**

i) Bar Element

ii) Truss Element

b) Estimate natural frequencies of axial vibrations of bar shown in figure below, using both consistent and lumped mass matrices and compare the results. Bar is having uniform cross-section with cross-sectional area A = 50×10^{-6} m^2, length L = 1.5 m, modulus of elasticity E = 2×10^{11} N/m^2 and density ρ = 7800 kg/m^3. Model the bar by using two elements. **[8]**



c) Explain the significance of lumped mass matrix and consistent mass matrix. Write lumped mass matrix for bar and beam element. **[4]**