Reg. No. : | | | | | | | | | | |

Question Paper Code: 31772

B.E. / B.Tech. DEGREE EXAMINATION, MAY 2017

Seventh Semester

Mechanical Engineering

01UME702 - FINITE ELEMENT ANALYSIS

(Regulation 2013)

Duration: Three hours Maximum: 100 Marks

Answer ALL Questions

PART A - (10 x 2 = 20 Marks)

1. Discuss the concept of potential energy
2. Summarize the meaning of weak formulation.
3. Point out the problems which are treated as one dimensional.
4. Define truss element.
5. Point out the applications of two dimensional problems.
6. Name the conditions to be satisfied in order to use axisymmetric element.
7. Classify the types of mass matrix.
8. Illustrate the phenomenon of damping.
9. Explain temperature gradient.
10. Define steady state heat transfer.

PART - B (5 x 16 = 80 Marks)

11. (a) Estimate the deflection at the centre of a simply supported beam of span length l subjected to a concentrated load P at its mid-point as shown in the fig.1. Use Rayleigh-Ritz method. (16)

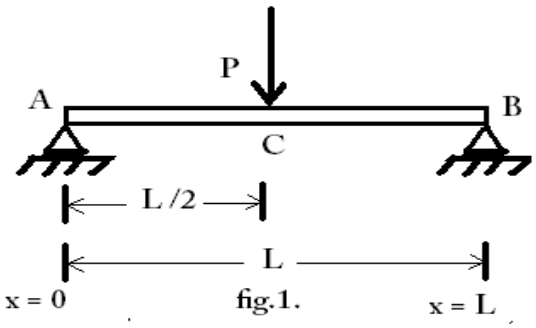

fig.1.

Or

(b) Consider the differential equation for a problem as $(d^2y / dx^2) + 300\ x^2 = 0$, $0 \leq x \leq 1$ with the boundary conditions y(0) = 0, y(1) = 0. Illustrate the solution of the problem using one coefficient trail function as $y = a_1x\ (1-x^3)$. Use (i) Point collocation method, (ii) Sub-domain collocation method. (iii) Least square method and (iv) Galerkin's method. (16)

12. (a) A rod of diameter 10 mm, length 200 mm and has nodal displacements due to axial loads as 1.2 mm and 2.8 mm. The position of the rod is shown in fig.2. Predict (i) the displacement at a point Q on the rod (ii) strain (iii) stress and (iv) the strain energy for the rod. Take E =210 Gpa. (16)

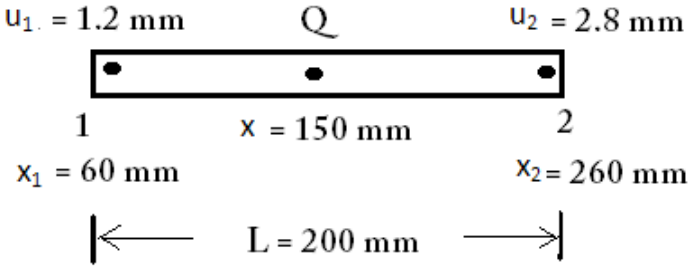

fig.2.

Or

(b) A stepped bar is subjected to an axial load of 200 kN at the place of change of cross section and material as shown in fig.3. Calculate (a) the nodal displacements (b) The reaction forces. Given $A_1 = 2400\ mm^2$, $A_2 = 600\ mm^2$, $E_1 = 70 \times 10^3\ N/mm^2$. $E_2 = 200 \times 10^3\ N/mm^2$. Where (1) - Aluminium and (2) – steel bar. (16)

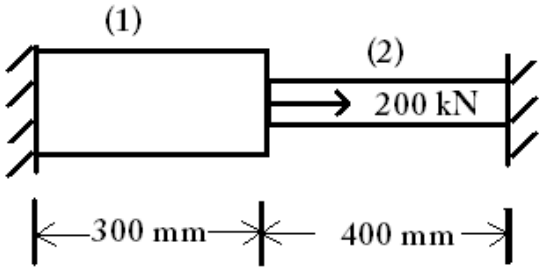

fig.3.

13. (a) The nodal coordinates of the triangular element are shown in the fig.4. At the interior point "I" the x coordinate is 3.3 and $N_1 = 0.3$. Infer N_2, N_3 and y coordinate of P. (16)

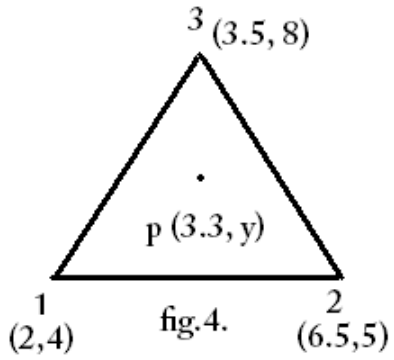

fig.4.

Or

(b) Examine the Cartesian coordinates of the point P which has local coordinates $\varepsilon = 0.8$ and $\eta = 0.6$ shown in the fig.5. (16)

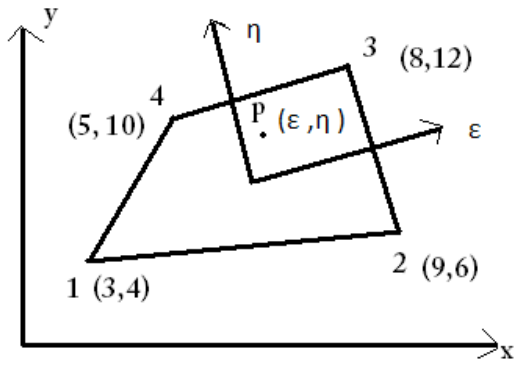

fig.5.

14. (a) Identify the natural frequencies of longitudinal vibration of the constrained stepped bar shown in fig.6 Also find the mode shapes. (16)

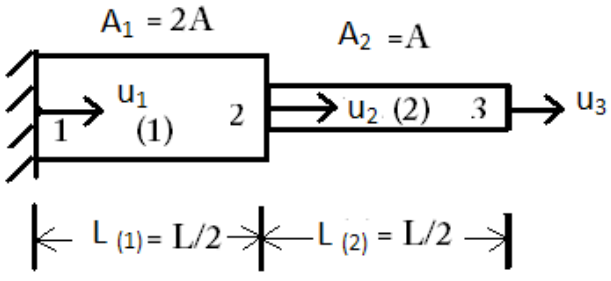

fig.6.

Or

(b) Evaluate the eigen values and frequencies for the stepped bar shown in fig.7. (16)

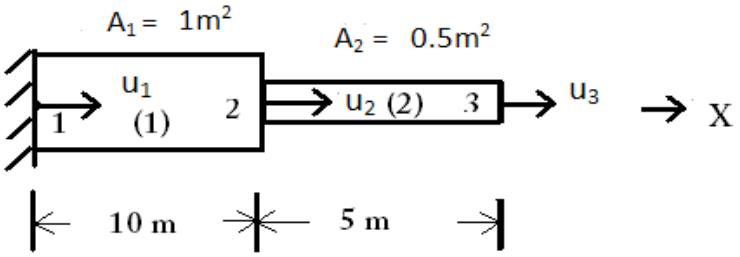

fig.7.

15. (a) A wall of 0.5mm thickness having thermal conductivity of 6W/Mk. The wall is to be insulated with a material thickness 0.1m having an average thermal conductivity of 0.3W/mk. The inner surface temperature is 1200° C and the outside of the insulation is exposed to atmospheric air at 30°C with heat transfer coefficient of 40 W/m^{2}K as shown in fig.8. Interpret the nodal temperatures. (16)

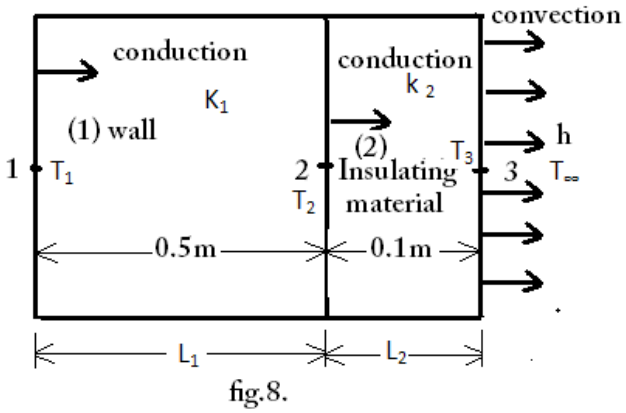

fig.8.

Or

(b) Summarize the element equations for the element shown in fiq.9. Which experiences convection on the side j k and its upper face: Take k = 7.5W/mm°C, h = 0.15W/mm^2 ° C, T_∞= 20°C and t = 1mm. (16)

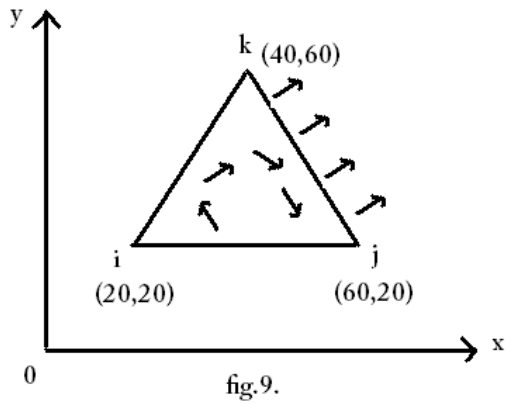

fig.9.

(All dimensions are in mm)