COLLEGE OF ENGINEERING, PUNE

T.Y.B. Tech. (Institute Level Elective-II)

(ISO2-4) Finite Elements in Engineering

End- Semester Examination

Year : 2012-13 | **Semester : II**

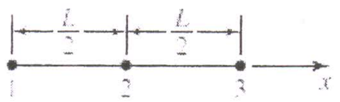
Max. Marks: 40 | Time: 3 Hour

Instructions: 1. **ALL** Questions are compulsory.
2. Assume suitable data if necessary.

Q.1 (a) Triangular elements have been used for modeling a heated flat plate. The *(x,y)* coordinates of nodes *i,j,* and *k* of an interior element are given as *(5,4),(8,6)* and *(4,8) cm* respectively. If the nodal temperatures are found to be $T_i = 100^0C$, $T_j = 80^0C$, and $T_k = 110^0C$, find the temperature at point P located at $(x_P, y_P) = (6,5)\,cm$ [04]

(b) The temperatures at the corner nodes of a rectangular element, in ^0C are given by $T_i = 90, T_j = 84, T_k = 75,$ and $T_l = 85$. If the length and width of the element are $x_{ij} = 15mm$ and $y_{il} = 10mm$, determine the temperature distribution in the element. [06]

(c) The nodes of a quadratic one-dimensional element are located at $x = 0, x = L/2,$ and $x = L$. Express the shape functions using Lagrange polynomial of order n, $L_j(x) = \prod_{i=1, i\neq j}^{n} \frac{x - x_i}{x_j - x_i}$ [03]

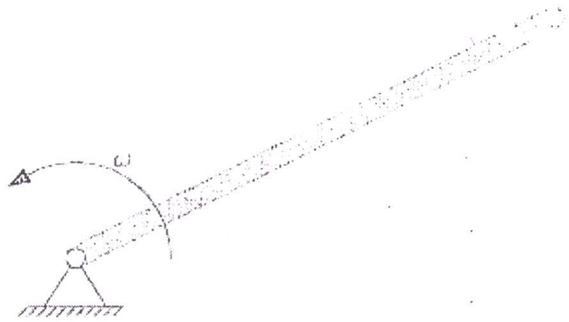


Q.2 (a) Explain in brief any *Two* finite elements that you have used for carrying out *Finite Element Analysis.* [08]

(b) Determine the axial stress distribution in a bar that is rotating at 500 *rpm* as shown in figure. The problem can be treated as one dimensional with the governing differential equation as follows: [06]

$$\frac{d}{dx}\left(EA\frac{du}{dx}\right)+\rho Ax\omega^2=0;0<x<L$$

$$u(0)=0;\ EA\frac{du(L)}{dx}=0$$



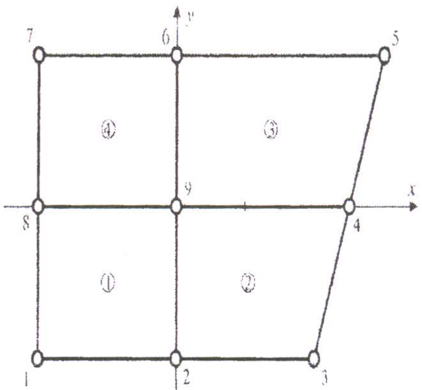
where *x* is the coordinate along the axis of the bar,*u(x)* is the axial displacement,*L*= length of the bar,E=Young's modulus, A=area of cross section, ρ=mass density, and ω= angular velocity in rad/s. The axial stress is $\sigma_x = Edu/dx$ .An exact analytical solution of the problemis $\sigma_{x,Exact}=\frac{\rho\omega^2}{2}(L^2-x^2)$.

Compare solution using one linear element[$u(x)=c_0+c_1x$].

$L=80cm; E=200GPa; A=250mm^2; \rho=7850kg/m^3$.

(c) Compute Jacobian for element 1 as shown below. [04]

Global Node Number	Nodal Coordinates
1	(−4, −3)
2	(0, −3)
3	(4, −3)
4	(5,0)
5	(6,3)
6	(0,3)
7	(−4,3)
8	(−4,0)
9	(0,0)



Q.3 Explain in brief the important steps you followed while carrying out *Mini-Project work.* [09]

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