BE-ME-VIII OLD FEA

Q. P. Code : 610801

(Old Course)

(04 Hours) **[Total Marks: 100**

N. B.
1) Question No.1 is compulsory
2) Attempt any FOUR questions from remaining six questions
3) Assume suitable data wherever necessary
4) Figures to the right indicate full marks

Q1. a) Develop element matrix equation using three linear elements and Rayleigh Ritz method- (15)

$$\frac{d^2u}{dx_2} + Cu - x^2 = 0; \quad 0 \le x \le 1$$

boundary conditions: $u(0) = 0$; $\left.\frac{du}{dx}\right|_{x=1} = 0$

Use Lagrange's linear shape function to derive EME. If C = 1, compare the values of u at x = 1/3 and x = 2/3 with exact solution. Find nodal unknowns.

b) Explain Iso-parametric, sub- parametric and super-parametric elements. (05)

Q.2 a) Derive Lagrange's Quadratic shape functions. What are the characteristics of shape functions? State the difference between shape functions and interpolation functions also plot the shape functions along length of the element. (10)

b) Explain followings: (10)
   i. Gauss elimination method
   ii. Advantages of weak form over non-weak form methods in FEA
   iii. Convergence requirements
   iv. Aspect ratio
   v. Weight function

Q.3 a) Use Newton Cote's formula to solve following integral- (10)

$$K_{23} = \int_0^{he} \frac{d\phi_2}{dx}\frac{d\phi_3}{dx}\,dx$$

$$\Phi_2 = \frac{4x}{h_e}\left[1 - \frac{x}{h_e}\right]$$

$$\Phi_3 = \frac{x}{h_e}\left[1 - \frac{2x}{h_e}\right]$$

No. of sampling points	W1	W2	W3	W4	W5	W6
03	1/6	4/6	1/6	-	-	-
04	1/8	3/8	3/8	1/8	-	-
05	7/90	32/90	12/90	32/90	7/90	-
06	19/288	75/288	50/288	50/288	75/288	19/288

[Turnover

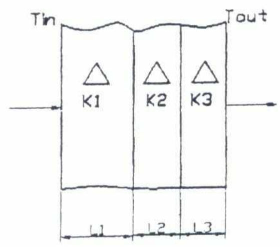
b) Solve the following governing differential equation- (10)

$\frac{d^2y}{dx^2} + 3x - 6y = 0$; BCs: $0 \leq x \leq 1$; $y(0) = y'(1) = 0$

using Rayleigh- Ritz method mapped over entire domain using one parameter and compare answers with exact.

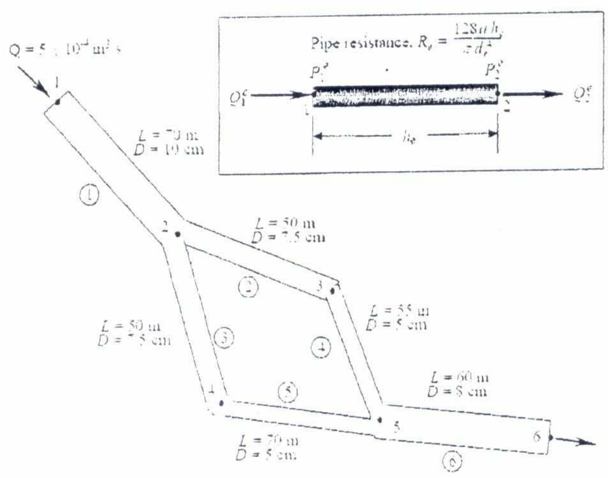
Q.4 a) Following data is given for one–dimensional, steady state, conduction heat transfer through a composite wall : Global P.V.s $T_{in} = 800\,^0C$, $T_{out} = 300\,^0C$, $K_1 = 10\ W/m\,^0C$, $K_2 = 50\ W/m\,^0C$, $K_3 = 5\ W/m\,^0C$, $L_1 = 0.10$ m, $L_2 = 0.20$ m, $L_3 = 0.05$ m (10)

Find the unknowns.



b) Derive shape functions for six noded triangular element. (10)

Q.5 a) Consider the hydraulic pipe network (the flow is assumed to be laminar) shown in Figure below. Write the condensed equations for the unknown pressures and flows (use the minimum number of elements.) (10)

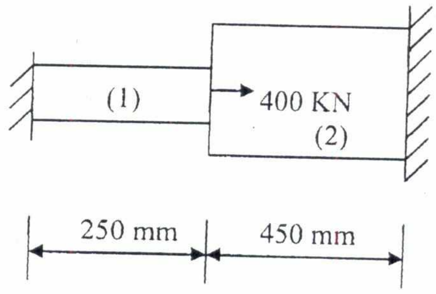


b) Find natural frequency of axial vibration of a bar of uniform cross section of 50 mm^2 and length 2.5m. Take, $E = 2 \times 10^5\ N/mm^2$ and $\rho = 7900 kg/m^3$. Take two linear elements. (10)

[Turnover

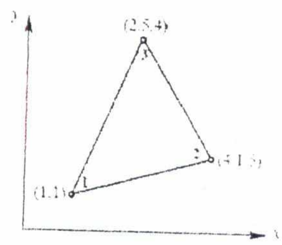
Q.6 a) An axial load of 400 KN is applied at 40^0C to the bar shown below. The temperature is then raised to 80^0C. (10)

Determine - i) Nodal displacements, ii) Reaction forces, iii) Element stresses

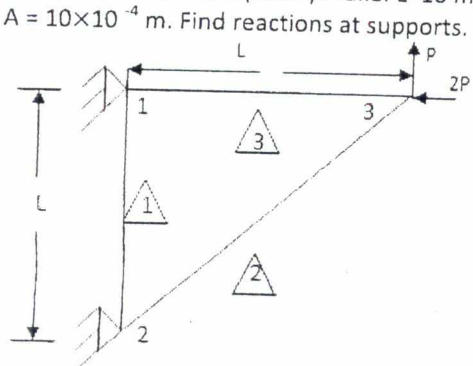


Elem. Material	(1) Aluminium	(2) Steel
E, N/m^2	$75x10^9$	$210x10^9$
A, mm^2	1000	1350
α, per ^0C	$25x10^{-6}$	$12x10^{-6}$

b) Calculate the linear interpolation functions for the linear triangular element shown in figure below- (10)



Q.7 a) Analyse the truss completely. Take: L=10 m, P=1000 N, E=2 x 10^7 KN/mm^2, A = 10×10^{-4} m. Find reactions at supports. (10)



b) Explain in short: (10)

i. Alternative method of deriving shape functions
ii. HRZ lumping scheme
iii. Boundary conditions
iv. Bilinear element
v. Patch test

[Turnover