

Sem.-VIII | Finite element Analysis | MECH | 11-12-

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

b) Explain followings: (10)
 i. Compatibility
 ii. Band width
 iii. Convergence criteria
 iv. Node numbering scheme
 v. Aspect ratio

Q2. a) Using Newton Cote's formula find values of M_{11} and M_{12} . (10)
 Where,

$$M_{ij} = \int_0^{h_e} x^2 \phi_i \phi_j dx$$

$\phi_1 = [1 - (x/h_e)]$ and $\phi_2 = (x/h_e)$. Compare your answers with exact.

b) Solve the following governing differential equation (10)

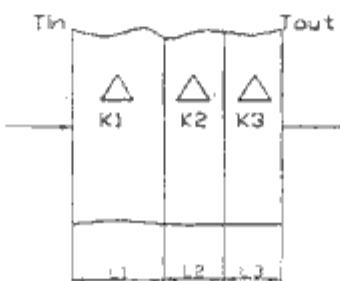
$$\frac{d^2y}{dx^2} - 10x^2 = 5 \quad \text{BCs: } 0 \leq x \leq 1; y(0) = y(1) = 0$$

 using-

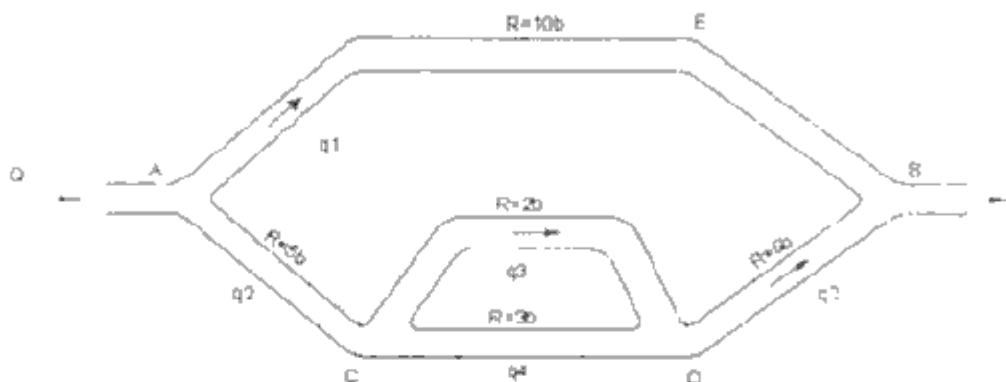
- i. Galerkin method with cubic polynomial for approximate function
- ii. Rayleigh-Ritz method mapped over entire domain using one parameter

Compare answers with exact.

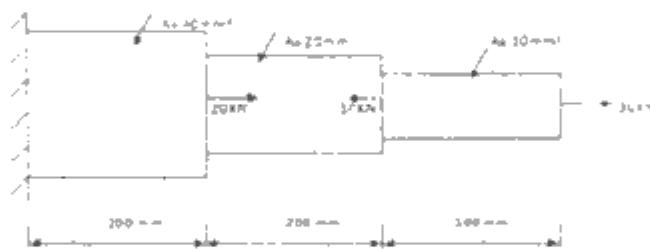
Q3. a) Following data is given for one-dimensional, steady-state, conduction heat transfer through a composite wall : Global P.V.s $T_{in} = 800^\circ\text{C}$, $T_{out} = 300^\circ\text{C}$, $K_1 = 10 \text{ W/m}^\circ\text{C}$, $K_2 = 50 \text{ W/m}^\circ\text{C}$, $K_3 = 5 \text{ W/m}^\circ\text{C}$, $L_1 = 0.10 \text{ m}$, $L_2 = 0.20 \text{ m}$, $L_3 = 0.05 \text{ m}$
 Find the unknowns.



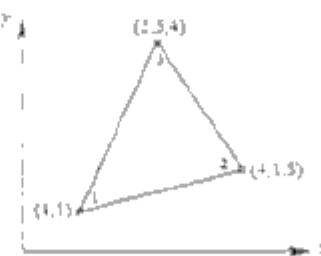
- b) Derive shape functions for nine noded quadrilateral elements in natural (10) coordinates.
- Q.4 a) Analyse following fluid network completely using EME directly. Where Q , b (10) are constants , R = branch resistance constant. $\Delta P = Rq$, ΔP = pressure drop. Establish Equation for steady state pressure and flow distribution.



- b) Find natural frequency of axial vibration of a bar of uniform cross section of (10) 30 mm^2 and length 2m. Take, $E = 2 \times 10^5 \text{ N/mm}^2$ and $\rho = 8000 \text{ kg/m}^3$. Take two linear elements.
- Q.5 a) Analyse following problem completely. Assume , $E= 200 \text{ Gpa}$. (10)



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



- Q.6 a) Define: (05)
- Primary variables
 - Element
 - Nodes
 - Natural coordinates
 - Convergence
- b) Develop element matrix equation for the most general element using Rayleigh Ritz (15) method.

$$\frac{d}{dx} \left(AE \frac{du}{dx} \right) - f = 0; \quad 0 \leq x \leq 1$$

Where, AE and f are constants. Use Lagrange's linear shape function to derive EME and use following data to solve global matrix equation.

Take 3 linear elements, A= 0.2m² for each element, E=100GPa for each element.

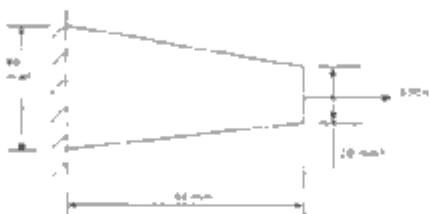
At x=0, u=0

At x=L = 12 cms, P = external force = 10 KN

F=0

Find displacements at nodes and the reactions.

Q.7 a) Solve for complete analysis. Where, E= 2×10^7 N/cm², $\rho = 75 \times 10^{-3}$ N/cm³. (10)



b) Explain in short: (10)

- i. Serendipity approach
- ii. Jacobian matrix
- iii. Consistent and lumped mass matrices
- iv. Boundary conditions
- v. Iso-parametric elements

QP Code: 2604

Correction:

Please provide following Newton Cote's table for Q. 2 a).

No. of Compl. points	W1	W2	W3	W4	W5	W6
2	1					
3	1/2	1/2				
4	1/3	4/3	-1/3			
5	1/5	3/8	-1/8	3/8		
6	1/90	31/90	-1/90	32/90	-1/90	31/90
	16/288	257/288	-1/288	50/288	-1/288	16/288

Query Update time: 11/12/2015 01:15 PM