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Question Paper Code : 21030

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Sixth Semester

Aeronautical Engineering

AE 2351/AE 61/AE 1007/10122 AE 602 — FINITE ELEMENT METHOD

(Regulation 2008/2010)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the governing differential equation for beam element.
2. What is LST element?
3. Differentiate between the Ritz Technique and Least squares method.
4. What are the properties of stiffness matrix?
5. Derive the constitutive matrix for plane strain analysis.
6. Derive the mass matrix for a 2 noded element.
7. State use of shape functions.
8. What are the isoparametric elements?
9. What is natural co-ordinate system?
10. List few commercial finite element analysis software packages.

PART B — (5 × 16 = 80 marks)

11. (a) A stepped bar is subjected to an axial load of 200KN at the place of change of cross section and material. Assume both ends are fixed.

(i) Aluminium bar

(ii) Steel bar

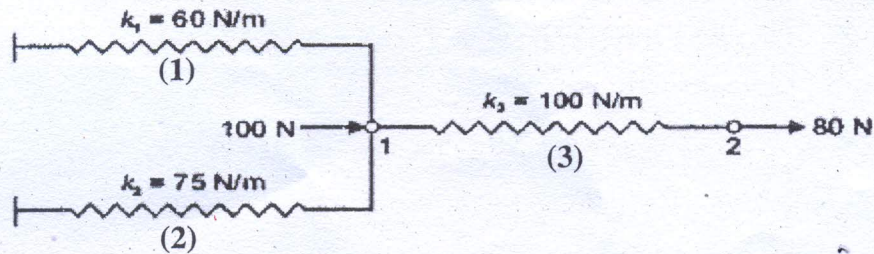
$$A_1 = 2400\text{mm}^2, E_1 = 70 \times 10^3 \text{ N/mm}^2, L_1 = 600\text{mm}$$

$$A_2 = 600\text{mm}^2, E_2 = 200 \times 10^3 \text{ N/mm}^2, L_2 = 300\text{mm}$$

Determine the stresses developed in two materials.

Or

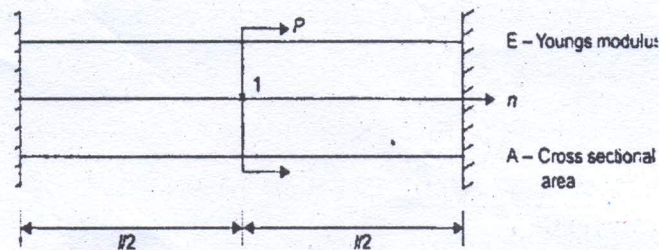
- (b) Determine the displacements of nodes 1 and 2 in the spring system shown Use Minimum of potential energy principle to assemble equations of equilibrium.



12. (a) Find the deflection at centre of simply supported beam of span length 'L' subjected to concentrated load "W" at its mid point. Use Rayleigh-Ritz method.

Or

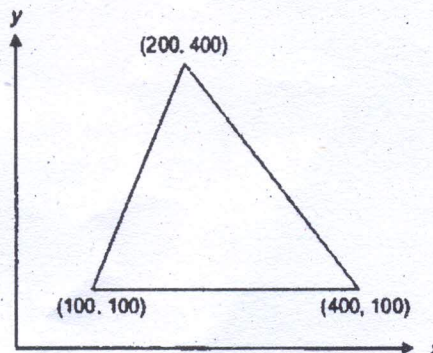
- (b) Using Rayleigh-Ritz method, determine the expressions for displacement and stress in a fixed bar subject to axial force P as shows in Fig. Draw the displacement and stress variation diagram. Take 3 terms in displacement function.



13. (a) Derive the shape functions for bilinear Rectangular element.

Or

- (b) For the CST element shown in Fig. obtain strain—displacement matrix. Take, $t = 20\text{mm}$, $E = 2 \times 10^5 \text{ N/mm}^2$.



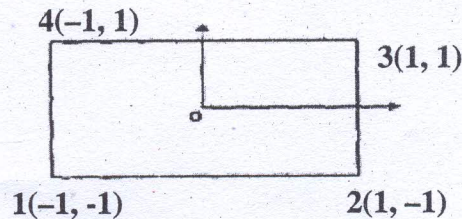
14. (a) A Four noded rectangular element is shown in fig. Determine the following

- (i) Jacobian matrix,
- (ii) Strain displacement matrix
- (iii) Element strains
- (iv) Element stresses, all dimensions are in mm

$$E = 210\text{GPa}, \mu = 0.25, \varepsilon = 0.5, \eta = 0,$$

$$\{\delta\} = [0, 0, 0.002, 0.004, 0.003, 0, 0.001, 0]^T$$

(Poisson's ratio).



Or

(b) Evaluate the integral

$$I = \int_{-1}^1 (5x^2 + 2x + 7) dx \text{ using Gauss quadrature method. Consider 2 points integration schme.}$$

15. (a) A Steel rod of diameter $d = 2$ cm, length $L = 5$ cm and thermal conductivity $K = 50$ W/m $^\circ$ C is exposed at one end to a constant temperature of 320° C. The other end in ambient air of temperature 20° C with a convection coefficient of $h = 100$ W/m 2 C. Determine the temperature at the midpoint of the rod.

Or

(b) Derive stiffness matrix and Load vectors for 2-D flow problem using Finite Element method.