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Question Paper Code : 51042

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Sixth Semester

Mechanical Engineering

080120032 — FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering)

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Any missing data may be suitably assumed.

Answer ALL questions.

PART A — ($10 \times 2 = 20$ marks)

1. What is the principle of skyline solution based on Gaussian elimination?

2. Mention the basic steps of Galerkin method.

3. State the significance of shape function.

4. What is post processing? Give an example.

5. Differentiate between plane stress and plane strain.

6. What are isoparametric elements?

7. List the importance of two dimensional plane stress and plane strain analysis.

8. Give four examples of practical application of axisymmetric elements.

9. What are the characteristics of shape functions?

10. What is meant by natural coordinate system?

PART B — (5 × 16 = 80 marks)

11. (a) Consider the differential equation $\frac{d^2y}{dx^2} + 500x^2 = 0,\ 0 \le x \le 1$, with boundary conditions $y(0) = y(1) = 0$. Find the solution of the problem using Galerkin method. Take trial solution as $y(x) = C_1 x(1-x) + C_2 x^2(1-x)$.

Or

(b) Use the Gaussian elimination method to solve the following simultaneous equations :

$$3x + y - z = 3$$
$$2x - 8y + z = -5$$
$$x - 2y + 9z = 8.$$

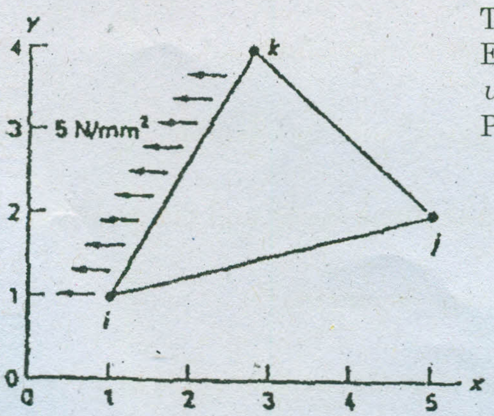
12. (a) A tapered bar of aluminum is having a length of 500 cm. The area of cross section at the fixed end is 80 cm^2 and the free end is 20 cm^2 with the variation of the sectional area as linear. The bar is subjected to an axial load of 10 kN at 240 mm from the fixed end. Calculate the maximum displacement and stress developed in the bar. (16)

Or

(b) A fixed beam *AB* of 5 m span carries a point load of 20 kN at a distance of 2 m from *A*. Determine the slope and deflection under the load. (16)

Assume $EI = 10 \times 10^3$ kN – m^2

13. (a) Compute the finite element equation for the LST element shown in Fig. 13(a). (16)

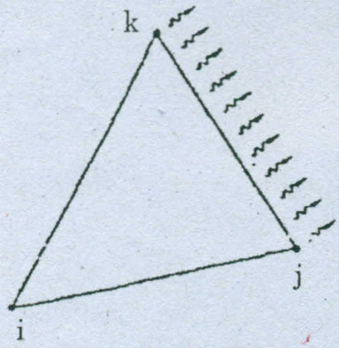


Thickness = 2 mm
E = 200 GPa
υ = 0.3
Plane stress

Fig. 13(a)

Or

(b) Determine the element matrices and vectors for the LST element shown in Fig. 13(b). The nodal coordinates are i (1, 1), j (5, 2) and k (3, 5). Convection takes place along the edge jk.



$K = 7.5$ W/mm°C
$h = 0.15$ W/mm^2°C
$T_\infty = 30$°C

Fig. 13(b)

14. (a) A triangular plate of thickness 9 mm has vertices P(40, 40), Q(100, 40) and R(70, 130). It is fixed at P and supported on rollers at Q. There is a vertical downward load of 5 kN applied at R. Take Young's modulus as 200 GPa. Determine the nodal displacements accounting for body weight. Take density of material as 7800 kg/m^3.

Or

(b) Establish the shape functions and derive the strain displacement matrix for an axisymmetric triangular element.

15. (a) Derive the element characteristics of a four node quadrilateral element.

Or

(b) Evaluate the intergrals

(i) $I = \int_{-1}^{1} \left[x^2 + \cos\left(\frac{x}{2}\right) \right] dx$. (8)

(ii) $I = \int_{-1}^{1} \left[3^x - x \right] dx$. (8)

Using appropriate Gaussian Quadrature.
