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Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 31042

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Sixth Semester

Mechanical Engineering

080120032 — FINITE ELEMENT ANALYSIS

(Common to Automobile Engineering)

(Regulation 2008)

Time : Three hours　　　　　　　　Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the advantages of Gaussian elimination technique.

2. What is Ritz method?

3. List any two sources of errors in finite element method.

4. Define shape function. Give its properties.

5. Define continuity.

6. When is triangular element preferred over quadrilateral elements?

7. Sketch a finite element model for a long cylinder subjected to an internal pressure using axisymmetric elements.

8. Distinguish between plane stress and plane strain conditions.

9. What is the salient feature of an isoparametric element?

10. Give the Lagrange equation of motion and obtain the equation of motion of a two degree of freedom system.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Discuss the importance of FEA in assisting design process. (6)

(ii) Solve the ordinary differential equation

$$\left(\frac{d^2y}{dx^2}\right)+10x^2=0 \text{ for } 0\le x\le 1$$

Subject to the boundary conditions $y(0)=y(1)$ using the Galerkin method with the trial functions $N_0(x)=0$; $N_1(x)=x(1-x^2)$. (10)

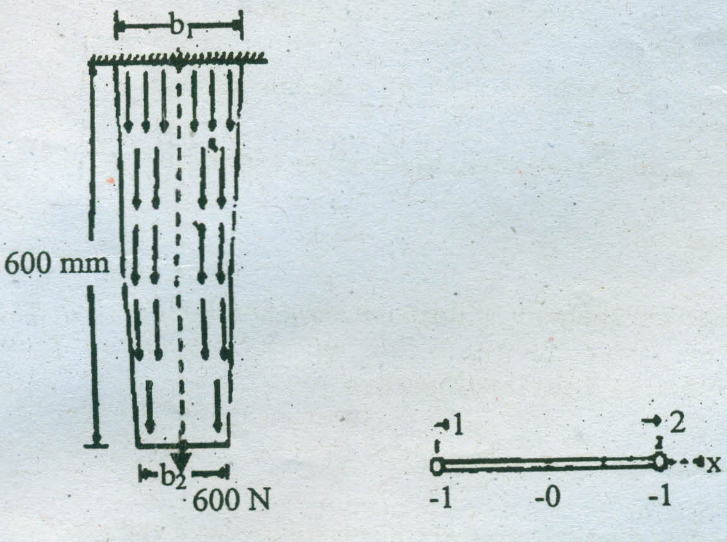
Or

(b) (i) Discuss the factors to be considered in discretisation of a domain. (10)

(ii) Solve the following equations using the gauss elimination method.

$2x_1+3x_2+x_2=9$, $x_1+2x_2+3x_3=6$, $3x_1+x_2+2x_3=0$. (6)

12. (a) Determine the extension of the bar shown in Fig. 12 (a) due to self weight and a concentrated load of 600 N applied at its end. Given b_1 = 200 mm. b_2 = 100 mm and t = 20 mm; Use two spar elements to solve the problem. Take $E=2\times10^5$ N/mm² and $\rho=0.8\times10^{-4}$ N/mm³. (16)



(i) (ii)

Fig. 12 (a)

Or

(b) A cantilever beam of length 3.4 m has an elastic spring support of stiffness 230 kN/m at, its free end, where a point load of 13 kN acts. Take Young's modulus as 200 GPa and area moment of inertia of the cross-section as 1×10^{-4} m⁴. Determine the displacement and slope at the node and the reactions. (16)

13. (a) Calculate displacements and stress in the given triangular plate, fixed along one edge and subjected to concentrated load at its free end. Take E = 70 GPa, thickness of the plate = 10 mm and Poisson's ratio = 0.3 (16)

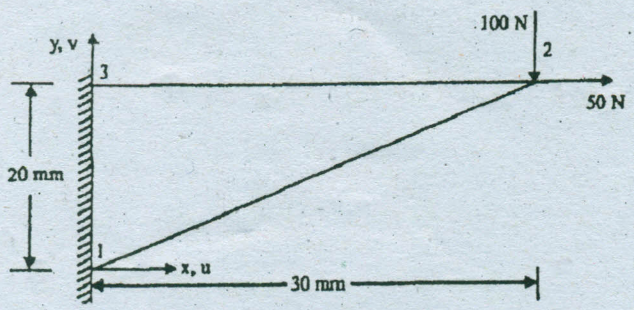


Figure 13 (a)

Or

(b) A circular fin of 40 mm diameter is fixed to a base maintained at 50°C as shown in figure 13 (b). The fin is insulated on the surface except the end face which is exposed to air at 25°C. The length of the pin is 1000 mm, the fin is made of metal with thermal conductivity of 37 W/m K. If the convection heat coefficient with air is 15 W/m² K. Find the temperature distribution at 250, 500, 750 and 1000 mm from base. (16)

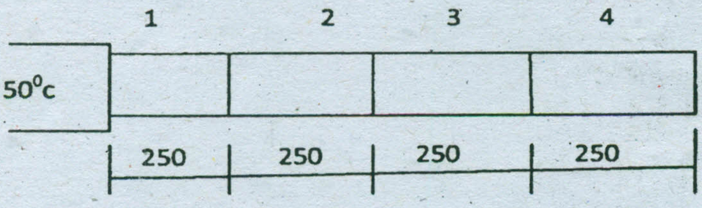


Figure 13 (b)

14. (a) What are lagrangian interpolation functions? Using lagrangian polynomials derive the shape functions for ID quadratic element/cubic element. (16)

Or

(b) Derive constitutive matrix for axisymmetric analysis. (16)

15. (a) Why higher order elements are needed? Derive the shape functions of an eight noded rectangular element. (16)

Or

(b) Deterrmine the Jacobian matrix for the quadrilateral element whose. Cartesian coordinates of the corner nodes are given by (0, –1), (–2, 3), (2, 4) and (5, 3). Evaluate the Jacobian matrix at the point (0.5, 0.5). (16)

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