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Question Paper Code : 80977

B.E./B.Tech. DEGREE EXAMINATIONS, NOVEMBER/DECEMBER 2025.

Fifth/Sixth/Seventh/Eighth Semester

Mechanical Engineering

CME 372 – CAD AND CAE

(Common to Mechanical Engineering (Sandwich)/
Mechanical and Automation Engineering)

(Regulations 2021)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the primary coordinates system used in computer graphics.
2. Distinguish about clipping and viewing.
3. Differentiate between analytical, interpolated and approximated curves.
4. List the characteristics of B-spline curves.
5. How does a ray tracing algorithm work?
6. How does Warnock's Algorithm handle complex scenes with overlapping polygons?
7. Brief the concept of stiffness matrix in FEM.
8. List the key properties that shape functions must satisfy.
9. Mention how Ritz Method is used in Finite Element Analysis.
10. Why is it crucial to maintain good mesh quality.

PART B — (5 × 13 = 65 marks)

11. (a) Explain about Sutherland-Hodgeman Polygon Clipping and discuss the advantages and limitations of this algorithm.

Or

- (b) A triangle ABC, A (5, 2), B (3, 5), C (7, 5). Find the transformed position if, (i) The triangle is rotated by 45° in clockwise direction, (ii) The triangle is rotated by 60° in anti-clockwise direction.

12. (a) A Hermite cubic spline curve is defined by two end points at (6, 5), and (1, 1) and their tangent vectors as (4, 4) and (6, 1). Find the position and tangent vector at the point dividing the curve into two equal segments.

Or

- (b) Sketch the CSG tree for each of the two solids shown in Fig. 12(b)

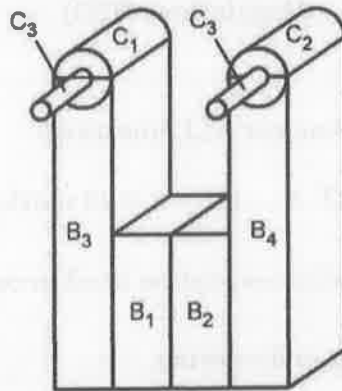


Fig.12(b)

13. (a) Imagine a scenario where a design team must send, (i) its design to CAE division which used ABAQUS to check the structural evaluation using FEA, (ii) to its rapid prototyping section for checking its aesthetics, and (iii) to manufacturing division for process planning and quality control activity. Recommend the standard formats that can be used for the above three condition. Also discuss the potential need for data exchange between different software.

Or

- (b) Explain the concept of hidden surface removal in computer graphics. Discuss the need for hidden surface removal algorithms and elaborate on two prominent techniques used for this purpose.

14. (a) Explain the step-by-step finite element procedure with suitable example.

Or

- (b) The loading and other parameters for a two-bar truss element is shown in Figure. 14 (b). Determine (i) the element stiffness matrix for each element (ii) Global Stiffness matrix (iii) nodal displacements (iv) reaction forces. Assume $E = 200 \text{ GPa}$.

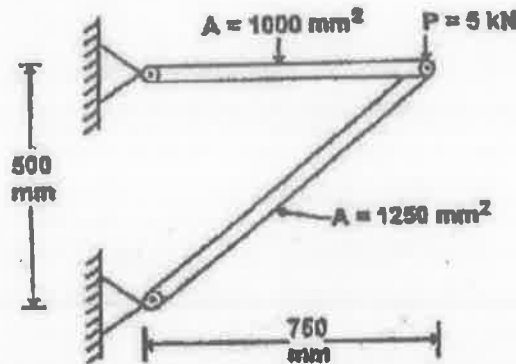


Fig. 14(b)

15. (a) Discuss the concepts of free meshing and mapped meshing in the context of finite element analysis (FEA). Compare and contrast the two techniques, highlighting their advantages and disadvantages. In what scenarios would you prefer one technique over the other?

Or

- (b) Define geometric nonlinearity in the context of finite element analysis (FEA). Explain the key factors that contribute to geometric nonlinearity in structural analysis.

PART C — ($1 \times 15 = 15$ marks)

16. (a) A cantilever beam is subjected to uniformly distributed load over entire span and its subjected to a point load at the centre of the span. Calculate the deflection using Rayleigh-Ritz method and compare with exact solutions.

Or

- (b) An axial load $P = 200 \times 10^3 \text{ N}$ is applied on a bar shown in Fig. 16(b) Using the penalty approach for handling boundary conditions, determine nodal displacements, stress in each material and reaction forces.

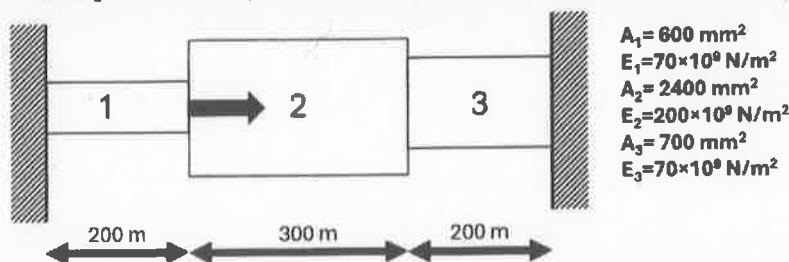


Fig. 16(b)

