

(REVISED COURSE)

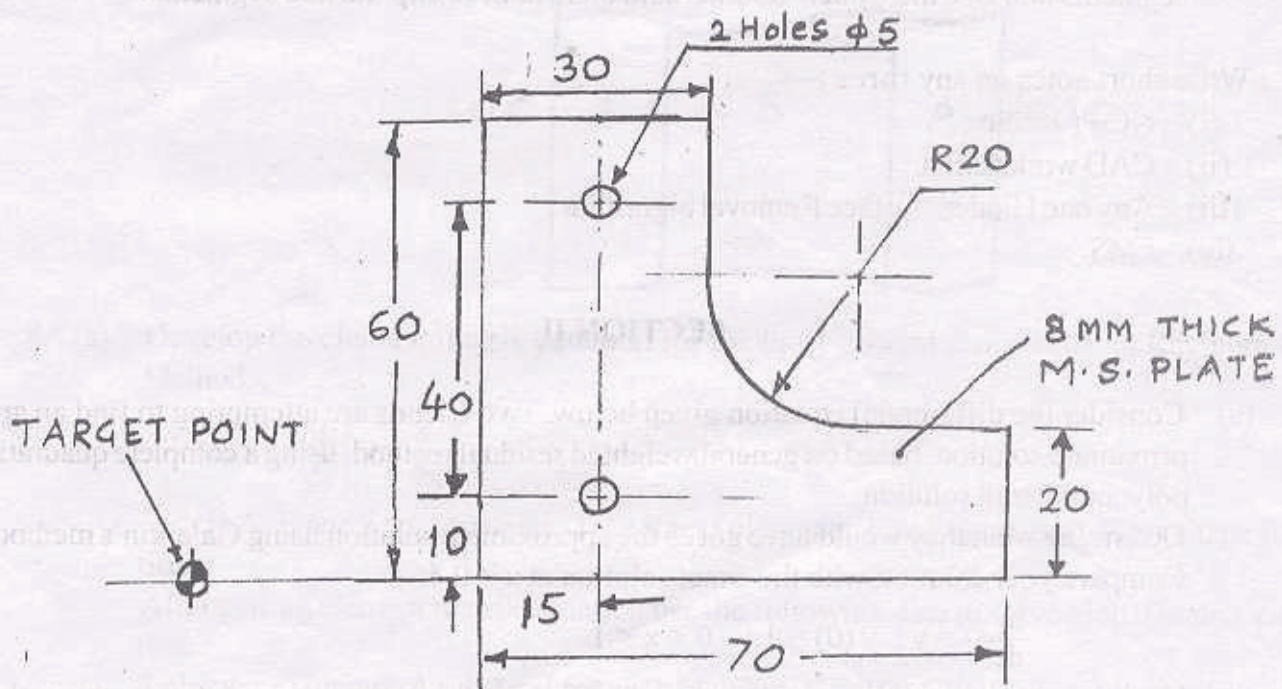
(4 Hours)

[Total Marks : 100

- N. B. :** (1) Question No.1 & Question No.6 are compulsory.  
 (2) Attempt any **two** from the remaining in **each** section  
 (3) Answers to the **two** sections must be written in **separate** answer books.  
 (4) Assume **suitable data** wherever required.  
 (5) **Figures** to the **right** indicate **full marks**

SECTION I

- 1 (a) Find the form of the matrix for reflection about a line L with slope m and y intercept (0, b). **10**  
 A triangle with vertices: P (1, 1), Q (7, 1) and R (1, 6) is to be reflected about the line  $3x + 2y + 4 = 0$ . Determine the coordinates of the vertices for a reflected triangle.
- (b) Write a complete APT part program to machine the outline of the geometry and drilling **10**  
 2 holes shown in the **Figure 1**. The component is 8 mm thick. The HSS Drill used is 5 mm diameter and the End Mill used is 10 mm in diameter. Assume suitable speed and feed for machining.



[TURN OVER

- BTE (M) VII Rev CAD/CAM 5/12/19
2. (a) Compare :— 12
- (i) Sequential approach & Concurrent Engineering approach to the product development process.
  - (ii) EIA and ASCII Tape Coding System
  - (iii) Straight CNC & Hybrid CNC
  - (iv) Constructive Solid Geometry and Boundary Representation.
- (b) Write down implicit and parametric expressions for a line, circle and ellipse. 3
3. (a) Explain (any two) :— 10
- (i) Artificial Intelligence in Design
  - (ii) Product Life Cycle & CAD/CAM
  - (iii) Properties of B-Spline Curve
- (b) Explain Briefly NC Co-ordinate system 5
4. (a) Find the matrix for mirror reflection with respect to the plane passing through the origin and having a normal vector whose direction is  $N = I + J + K$  9
- (b) A rectangular window whose left hand corner is at L (1,2) and the upper right hand corner is at R (9, 8). Co-ordinates of the points A, B, C, D are as below :— 9
- A (11,6), B (11, 10), C (6, 6), D (8, 9), E (2,3) and F (8,4). Find the region codes for the end points of the Lines AB, CD and EF. Find the clipping categories for the line segments and Use the Cohen-Southerland algorithm to clip the line segments.
5. Write short notes on any **three** :— 15
- (i) NC Procedure
  - (ii) CAD workstation
  - (iii) Any one Hidden Surface Removal algorithm
  - (iv) FMS.

## SECTION II

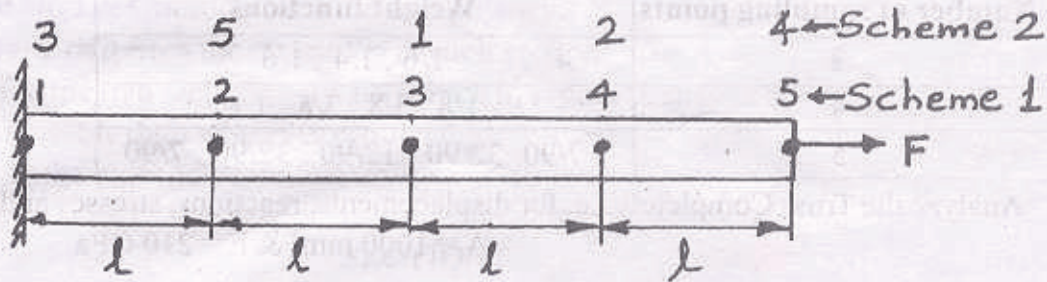
6. (a) Consider the differential equation given below. Two friends are attempting to find an approximate solution, based on general weighted residual method, using a complete quadratic polynomial trial solution. 14
- Determine what they would have got as the approximate solution using Galerkin's method. Compare your solution with the exact solution at  $x = 0.4$ .

$$\frac{dy}{dx} = y; y(0) = 1; 0 < x < 1$$

Now they wanted to improve the approximation but keep the number of parameters the same. One of them tried to choose higher order weighting functions, keeping the trial solution as the same, simple complete quadratic polynomial. The other preferred to use Galerkin method & so dropped linear term but added cubic term to the trial function. Find the result that both of them would have got and analyze their solution strategies.

- (b) For the bar shown in Figure below, give the assembled stiffness matrix for the two node numbering schemes indicated. What effect does node numbering have on the assembled matrix? 6

Area of c/s is A; Young's Modulus is E.

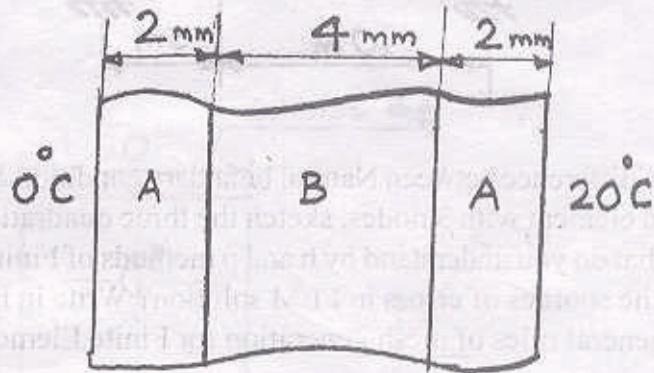


7. (a) Solve the following differential equation using Finite Difference Method & compare the answers with the exact solution at  $x = 0.5$  6

$$\frac{d^2y}{dx^2} + y - 2 = 0, 0 \leq x \leq 1, y(0) = 0 \text{ \& } y(1) = 0$$

- (b) Using Finite Element Method, determine the temperature distribution in the wall shown in the Figure below and calculate the heat flow through the wall thickness. 9

A: Steel, B: Insulation,  $K_A = 55 \times 10^{-3} \text{ W/mm } ^\circ\text{C}$ ,  $K_B = 0.1 \times 10^{-3} \text{ W/mm } ^\circ\text{C}$



8. (a) Develop the element matrix equation for the most general element using Rayleigh Ritz Method. 10

$$\frac{d}{dx} \left( AE \frac{du}{dx} \right) + f = 0, 0 \leq x \leq L$$

Where  $A$ ,  $E$  and  $f$  are constants. Take linear elements. Use Lagrange's Linear shape functions.

After getting element matrix equation use the following data to solve global matrix equation.

3 elements (linear),  $A = 0.1 \text{ m}^2$  for each element.  $E = 100 \text{ GPa}$  for each element.

At  $x = 0$ ,  $u = 0$  and at  $x = L = 12 \text{ cm}$ ,  $P = \text{External Force} = 10 \text{ kN}$ ,  $f = 0$ . Find displacements at nodes and Reactions. Write each step neatly.

- (b) Explain the basic units of a Typical Finite Element Program. 5

9. (a) Use Newton-Cotes Integration formula to evaluate—

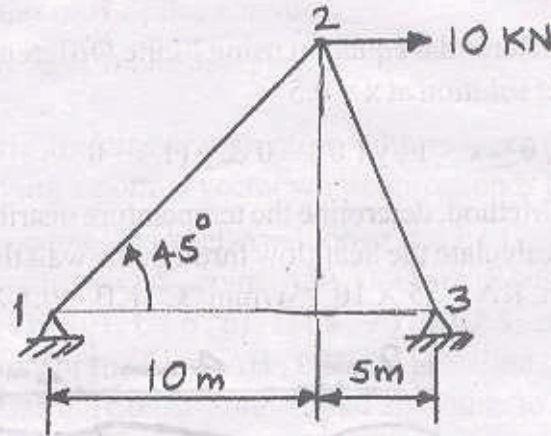
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$$K = \int_0^{hc} \left( \frac{d^2\phi}{dx^2} \right)^2 dx \quad \text{where } \phi = 1 - 3 \left\{ \frac{x}{h} \right\}^2 + 2 \left\{ \frac{x}{h} \right\}^3$$

Number of sampling points	Weight functions
3	1/6, 1/4, 1/6
4	1/8, 3/8, 3/8, 1/8
5	7/90, 32/90, 12/90, 32/90, 7/90

(b) Analyze the Truss Completely i.e. for displacements, reactions, stresses and strains.  
 $\Lambda = 1000 \text{ mm}^2$  &  $E = 210 \text{ GPa}$

10



10. (i) What is the difference between Natural boundary condition & Essential boundary condition 15  
 (ii) For the rod element with 3 nodes, sketch the three quadratic shape functions  
 (iii) Explain what do you understand by h and p methods of Finite Element Analysis?  
 (iv) What are the sources of errors in FEM solution? Write in brief.  
 (v) State the general rules of mesh generation for Finite Element formulation.