

Time Allotted : 3 hrs

Full Marks : 70

*Figures out of the right margin indicate full marks.**Candidates are required to answer Group A and
any 5 (five) from Group B to E, taking at least one from each group.**Candidates are required to give answer in their own words as far as
practicable.***Group – A**
(Multiple Choice Type Questions)1. Choose the correct alternative for the following: **10 × 1 = 10**

- (i) If we have to resize a 1024×768 image to one that is 640 pixels wide with same aspect ratio, then height of the resized image will be
(a) 500 pixels (b) 380 pixels (c) 480 pixels (d) 1024 pixels.
- (ii) Raster scan display means that
(a) top to bottom and right to left (b) left to right and top to bottom
(c) bottom to top and left to right (d) bottom to top and right to left.
- (iii) The initial decision parameter for Bresenham's generalized line drawing algorithm is
(a) $3\Delta y - \Delta x$ (b) $2\Delta x - \Delta y$ (c) $3\Delta x - \Delta y$ (d) $2\Delta y - 3\Delta x$.
- (iv) If starting point of a line is to be at left of the terminating point and slope of line is less than one then recursive expression for 'y' coordinate increment will be
(a) $y_{k+1} = y_k - m$ (b) $y_{k+1} = y_k - \frac{1}{m}$
(c) $y_{k+1} = y_k + m$ (d) $y_{k+1} = y_k + \frac{1}{m}$.
- (v) Which matrix is required for translating a two-dimensional point (x,y), 5 units in x-direction and 10 units in y-direction?
(a) $\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 1 & 5 & 0 \\ 0 & 1 & 10 \\ 0 & 0 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} 5 & 0 & 1 \\ 0 & 10 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 & 5 \\ 0 & 0 & 10 \\ 1 & 0 & 0 \end{bmatrix}$.

- (vi) The two dimensional matrix transformation for rotation with an angle θ with the axis in the anticlockwise direction is
(a) $\begin{bmatrix} \cos \theta & \sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$
(c) $\begin{bmatrix} -\cos \theta & -\sin \theta & 0 \\ \sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} \cos \theta & -\sin \theta & 0 \\ -\sin \theta & \cos \theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$.
- (vii) Parametric equation of a line between points (23,14) and (56,33) in terms of parameter 'u' ($0 \leq u \leq 1$) is
(a) $P(u) = [56 \ 33] + [23 \ 19]u$ (b) $P(u) = [23 \ 14] + [23 \ 19]u$
(c) $P(u) = [56 \ 33] - [23 \ 19]u$ (d) $P(u) = [23 \ 14] - [23 \ 19]u$.
- (viii) Full form of CNC is
(a) Conventionally Numerical Controlled
(b) Critically Numerical Controlled
(c) Computerized Numerically Controlled
(d) Computerized Numbered Controlled.
- (ix) Tool nose radius compensation on left side is done by the following 'G' code
(a) G91 (b) G90 (c) G41 (d) G42.
- (x) To rotate spindle clockwise, following 'M' code is used
(a) M03 (b) M04 (c) M08 (d) M06.

Group – B

2. (a) Discuss about IGES and STEP Graphics Standards in detail.
(b) Using Bresenham's Circle drawing algorithm calculate pixel positions of a circle for the 1st quadrant part only with centre at origin (0,0) and of radius 4 units.
3. A triangle PQR has its vertices at P (0,0), Q (4,0) and R (2,3). It is to be translated by 4 units along X-direction and 2 units along Y-direction. Then it is to be rotated in anticlockwise direction about new position of 'R' through 90 degree and next it is to be enlarged by 2 times about new position of 'P'. Find new coordinates of the triangle.

5 + 7 = 12**2 + 6 + 4 = 12**

Group – C

4. (a) Write down different limitations for non-parametric representation of curves in CAD system.
- (b) Line L1 is passing through points P1 (1,7) and P2 (7,2) and line L2 is passing through points P3 (1,2) and P4 (6,8). Find the parametric equation of these two lines L1 and L2. Also find point of intersection of these two lines L1 and L2.

$$4 + (3 + 5) = 12$$

5. (a) Mention different types of solid primitives used in CAD system with schematic illustration for each.
- (b) Discuss in detail about 'Boundary Representation (B-rep)' methodology for solid modelling with required and relevant schematic representations.

$$4 + 8 = 12$$

Group – D

6. Discuss in detail about various types of elements used for 'Finite Element Analysis' of any physical problem with schematic representation of each one mentioning their respective nodal DOF.

$$8 + 4 = 12$$

7. For the truss in Figure 1 below, a horizontal load of 10 kN is applied in x-direction at node 2. Also consider $E = 207 \text{ GPa}$ and $A = 960 \text{ mm}^2$ for each member. Now determine the global stiffness matrix for the problem and also write the load matrix, deflection matrix and FEA formulation.

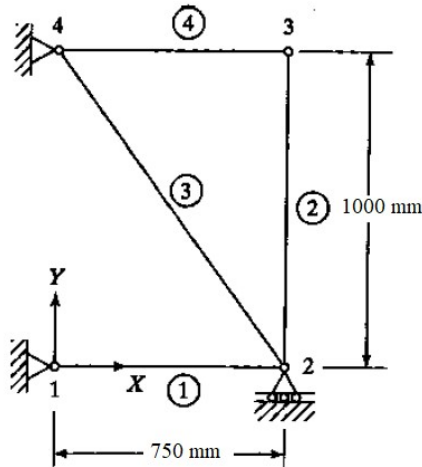


Figure 1

$$8 + 4 = 12$$

Group – E

8. (a) With help of a block diagram, show computational elements of a CIM system.
- (b) Write a part program to manufacture the product as shown in Figure 2 below in a CNC machine with spindle speed 1500 RPM and feed rate 1mm/Revolution. Consider all the dimensions in mm.

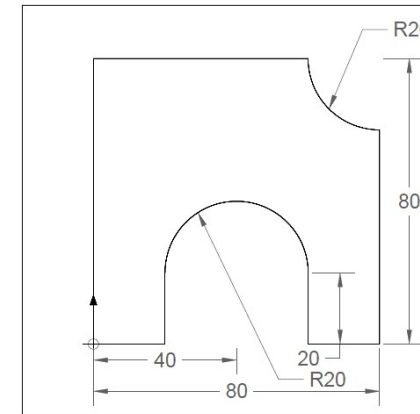


Figure 2

$$7 + 5 = 12$$

9. (a) What are the differences between 'Cutter Location Data' and 'Part Programming' in CNC machining?
- (b) Write a part program to manufacture the product as shown in figure 3 below with spindle speed 1500 RPM and feed rate 1mm/rev. Here the job dia is 35mm. Consider all the dimensions in mm.

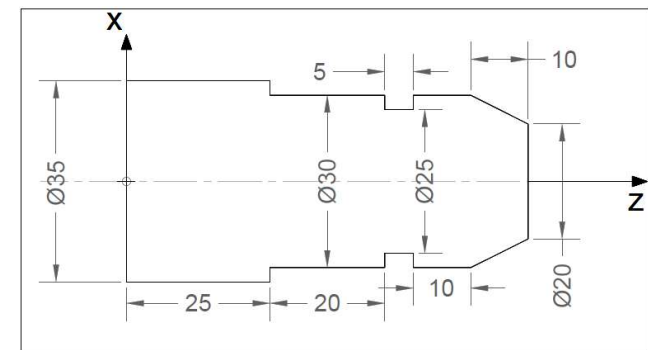


Figure 3

$$3 + 9 = 12$$