CAD / CAM
(MECH 4121)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

Candidates are required to give answer in their own words as far as practicable.

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Which of the following is not a graphics standard?
(a) GKS (b) IGES (c) UNIX (d) PHIGS.

(ii) Which of the following is not a graphic primitive?
(a) Point (b) Line (c) Spline (d) Doughnut.

(iii) 3×3 homogeneous transformation matrix for rotation of an object about origin by angle θ with respect to x-axis in anti-clockwise 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) $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

(iv) G91 code is used for
(a) absolute co ordinate system (b) incremental co ordinate system
(c) linear Interpolation (d) rapid Interpolation.

(v) The shape of the Bezier curve is controlled by
(a) Control Points (b) Knots
(c) End Points (d) Tangents at knots.

(vi) If a line between points (3,4,2) and (12,17,10) is represented parametrically then tangent of this line would be represented by which of the following vectors?
(a) $\hat{\imath} + \hat{\jmath} + \hat{k}$ (b) $9\hat{\imath} + 13\hat{\jmath} + 8\hat{k}$
(c) $9\hat{\imath} + 21\hat{\jmath} + 8\hat{k}$ (d) $9\hat{\imath} + 13\hat{\jmath} + 12\hat{k}$

(vii) Which of the following is not a synthetic surface?
(a) Bezier surface (b) B-spline surface
(c) Coon surface (d) Surface of revolution.

(viii) Stiffness of a bar having cross-sectional area 'A', length 'L' and modulus of elasticity of the bar material 'E' is

(a) AEL (b) $\frac{AL}{E}$ (c) $\frac{AE}{L}$ (d) $\frac{A}{LE}$.

(ix) M-codes are also known as

(a) preparatory codes (b) tool selection codes
(c) spindle speed codes (d) miscellaneous codes.

(x) Which of the following is a three-dimensional element?

(a) BEAM element (b) TRIA element
(c) TETRA element (d) QUAD element.

Fill in the blanks with the correct word

(xi) Transformation matrix of 'Reflection' or 'Mirror' operation about X-axis is _____.

(xii) Parametric representation of a straight line between (4, 5) and (12, 17) is _____.

(xiii) G-code used to produce dwell for a specified time is _____.

(xiv) M-code used to stop the machine spindle is _____.

(xv) G-code used to give input of cutter offset data is _____.

Group - B

2. (a) Compare IGES and STEP graphics standard in detail. *[(CO1)(Remember/LOCQ)]*

(b) Using Generalized Bresenham algorithm generate all the intermediate pixels to rasterize a line from device coordinate (12, 20) to (16, 26). Finally represent stepwise coordinates of all the pixels in tabular form and show all those pixels graphically through manual drawing of pixels in enlarged form. *[(CO1)(Analyse/IOCQ)]*

5 + (4 + 3) = 12

3. The vertices of a triangle ABC are situated at points A (15, 30), B (25, 35) and C (5, 45). Find the coordinates of the vertices if the triangle is first rotated by 10° in a counter-clockwise direction about the vertex 'B' and then translated by 6 units along X-direction and by 7 units along Y-direction with respect to the current position of vertex 'A'. Draw the triangles at its initial and final positions on a graph paper. *[(CO1)(Analyse/HOCQ)]*

(9 + 3) = 12

Group - C

4. (a) A line is drawn between points (x_1, y_1) and (x_2, y_2). Represent it parametrically and write its tangent vector. *[(CO2) (Understand/IOCQ)]*

(b) There are two lines 'L1' and 'L2'. 'L1' is from (3, 7) to (12, 21) and 'L2' is from (10, 5) to (4, 18). Write down parametric equations of these two straight lines and determine parametrically the co-ordinate of intersecting point of these two lines. Also justify parametrically whether these two lines are perpendicular to each other or parallel to each other. *[(CO2) (Analyse/HOCQ)]*

3 + (1 + 4 + 4) = 12

5. (a) Write in detail about Bezier Curve with mathematical explanations.

[(CO3)(Understand/IOCQ)]

(b) The coordinates of four points are given by $\mathbf{P_0} = [\mathbf{2\ 3\ 0}]^{\mathbf{T}}$, $\mathbf{P_1} = [\mathbf{4\ 5\ 0}]^{\mathbf{T}}$, $\mathbf{P_2} = [\mathbf{6\ 8\ 0}]^{\mathbf{T}}$ and $\mathbf{P_3} = [\mathbf{9\ 2\ 0}]^{\mathbf{T}}$. Find the equation of the Bezier curve. Also, find the points on the curve for parameter values of u=0, 0.25, 0.5, 0.75 and 1.

[(CO3)(Analyse/HOCQ)]

5 + 7 = 12

Group - D

6. Two trolleys are connected by the arrangement of springs shown in Fig. 1 below. (i) determine global stiffness matrix using Rayleigh-Ritz Method (ii) If k=8 N/mm, F_1 = 50 N and F_2 = 70 N, compute the displacement of each trolley and the force in each spring.

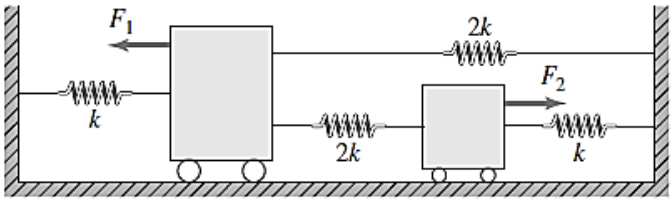


Fig. 1

[(CO4)(Analyse/HOCQ)]

(9 + 3) = 12

7. (a) What is Plane Stress and Plane Strain condition for an object made of linear, elastic, isotropic material? Give your answer with suitable examples.

[(CO4)(Understand/IOCQ)]

(b) Write down stress-strain constitutive relation for plane stress and plane strain conditions.

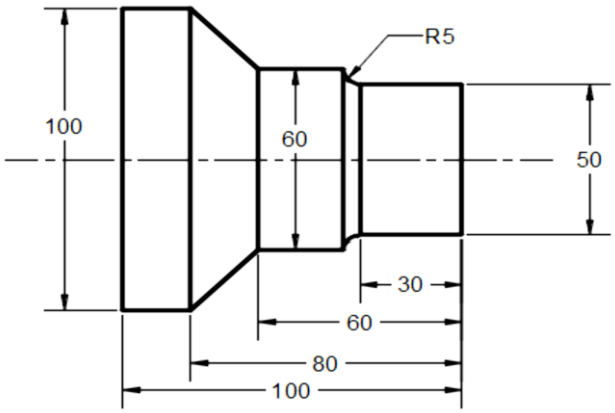
[(CO4)(Remember/IOCQ)]

6 + 6 = 12

Group - E

8. (a) Use turning cycle (G70, G71) for the following component (all dimensions are in mm) to make a part program on CNC turning machine using Fanuc controller with work material - Aluminium and Tool material - HSS. Work size Ø100x120 mm, Tool Type-Single point cutting tool, Turret no. 1, Machine Tool used - CNC Turning. Cutting speed = 255RPM, feed rate = 0.35mm/rev. Assume all the data if required.

[(CO6)(Evaluate/HOCQ)]



(b) Define the function of the following M code- (i) M00 (ii) M01 (iii) M02 (iv) M04.
[(CO5)(Remember/LOCQ)]

8 + 4 = 12

9. (a) Write a detailed note on Computer Integrated Manufacturing process accompanying with suitable figures and examples. *[(CO5)(Remember/IOCQ)]*

(b) The component to be machined is shown in Fig. 2 below. It is assumed that only the outside part is to be machined. The tool to be used is a 20 mm diameter slot drill. write down a complete NC program to execute the machining in CNC milling machine. *[(CO6)(Analyse/IOCQ)]*

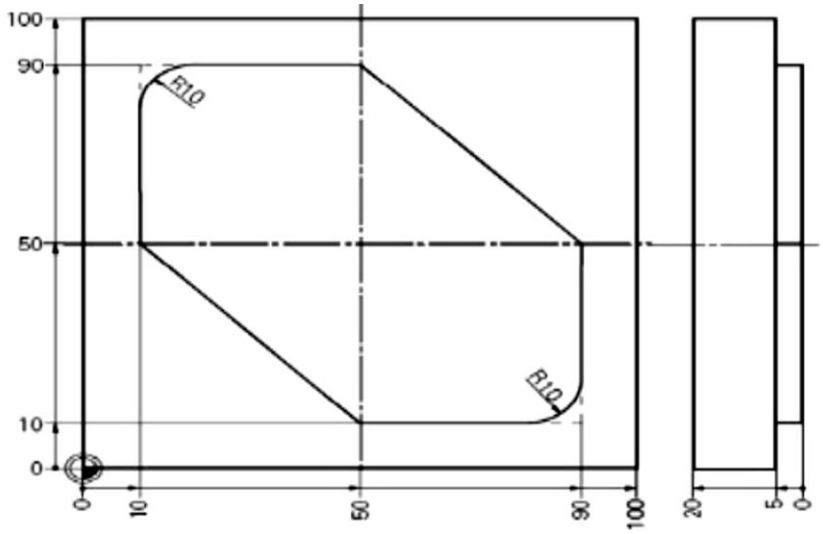


Fig. 2

4 + 8 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	9.37	40.63	50