CAD / CAM
(MECH 4121)

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)   Which of the following is not a Graphics Card? [CO-1 (LOCQ)]
          (a) VGA   (b) SVGA   (c) XGA   (d) PHIGS.

    (ii)   For Bresenham's generalized line drawing algorithm if Interchange=0 and initial decision parameter $\bar{e}$ is greater than one then initial decision parameter is modified as [CO-1, (LOCQ)]
          (a) $\bar{e} = \bar{e} + 2\Delta y$ (b) $\bar{e} = \bar{e} - 2\Delta x$
          (c) $\bar{e} = \bar{e} - 3\Delta x$ (d) $\bar{e} = \bar{e} + 3\Delta y$
          Here, Δx and Δy are absolute deference between final and initial coordinates of x and y respectively.

    (iii)   3 × 3 homogeneous transformation matrix for rotation of an object about origin by angle θ anti-clockwise is [CO-1, (LOCQ)]

    (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)   Which one of the following is not an aesthetic curve? [CO-2, (LOCQ)]
          (a) Parabola   (b) Spline   (c) Bezier curve   (d) NURBS

    (v)   To model a solid entity, which method is not relevant: [CO-3, (LOCQ)]
          (a) DDA   (b) Bresenham   (c) CSG   (d) Ruled.

    (vi)   The continuity of a cubic spline is. [CO-2, (LOCQ)]
          (a) C^0 Continuity   (b) C^1 Continuity
   (c) C^2 Continuity   (d) C^3 Continuity.

(vii)   Stiffness matrix of a BAR element transformed to global coordinate for solving truss problem is a: [CO-4, (LOCQ)]
(a) 3 × 3 matrix   (b) 4 × 4 Matrix
(b) 2 × 2 matrix   (d) single column matrix.

(viii)   Full form of CNC is [CO-5, (LOCQ)]
(a) Computer Numerical Control   (b) Computer Navigated Control
(c) Computer Number Control   (d) Computer Notation Control.

(ix)   During the execution of a CNC part program block NO20 GO2 X45.0 Y25.0 R5.0 the type of tool motion will be[CO-6, (IOCQ)]
(a) Circular Interpolation – clockwise
(b) Circular Interpolation – counter clockwise
(c) Linear Interpolation
(d) Rapid feed.

(x)   NC contouring is an example of [CO-6, (LOCQ)]
(a) Continuous path positioning   (b) Point-to-point positioning
(c) Absolute positioning   (d) Incremental positioning.

Group – B

2. (a)   Write a detailed note on IGES graphic exchange format.
[(CO1) (Understand/LOCQ)]

    (b)   Rasterize a line from (3,2) to (5,8) mm on a display which is mapped to approximately (400×320) mm. The resolution of the screen is 640×480 pixels. Calculate the intermediate pixel positions of this rasterization using generalized Bresenham algorithm and represent them schematically, drawing a suitable pixel matrix. [(CO1) (Explain/IOCQ)]

4 + 8 = 12

3. Consider the line L and the triangle ABC shown in Fig. 1.0. The equation of the line L is $y = \frac{x}{4} + 3$

The co-ordinates of the vertices A, B and C of the triangle are (3, 5), (5, 7) and (3, 7) respectively. Calculate the modified co-ordinates of the vertices of the triangle after reflection about the line L. [(CO1) (Apply/HOCQ)]
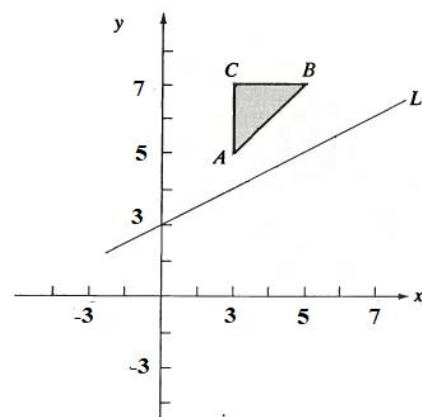
Fig.1

12

Group – C

4. Line L1 is passing through the points P1 (2,5) and P2 (7, 1) and line L2 through P3 (3,1) and P4 (6,9). Find the parametric equations for the lines. Also determine: (a)

whether two lines are parallel or perpendicular, (b) the point of intersection of the two lines. [(CO2) (Apply/HOCQ)]

(4 + 4 + 4) = 12

5. (a) Mention all the methods of solid representation in CAD.
   [(CO3) (Remember/LOCQ)]
   (b) Write in detail about Constructive Solid Geometry (CSG) method of solid representation. [(CO3) (Explain/IOCQ)]

4 + 8 = 12

Group – D

6. Figure 2 shows a two-member plane truss supported by a linearly elastic spring. The truss members are of a solid circular cross section having d = 20 mm and E = 80 GPa. The linear spring has stiffness constant 50 N/mm. Determine Global Stiffness matrix of the problem and displacement of the load point. [(CO4) (Analyze/IOCQ)]
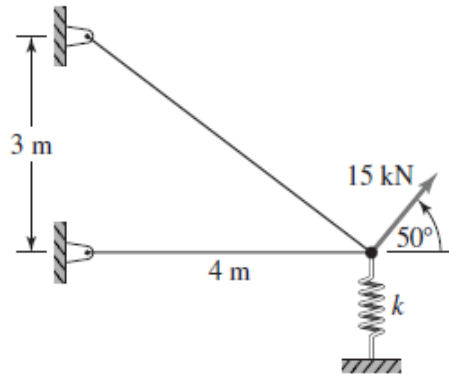
Fig.2

(5 + 7) = 12

7. Discuss in detail about various elements used in FEA simulation by showing their elemental DOF schematically. [(CO4) (Analyze/IOCQ)]

12

Group – E

8. (a) Write down the differences between NC and CNC. [(CO5) (Remember/LOCQ)]
   (b) Write in detail about benefits of CIM. [(CO5) (Assess/IOCQ)]

4 + 8 = 12

9. (a) Explain the applications of CAM in 'Manufacturing Planning'.
   [(CO6) (Explain/IOCQ)]
   (b) 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/IOCQ)]
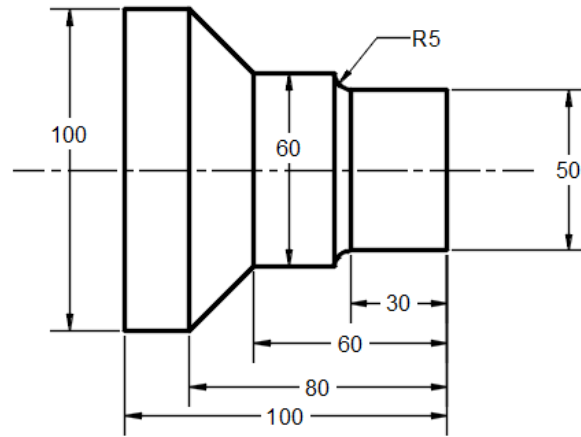
3 + 9 = 12

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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	30%	43.33%	26.67%

Course Outcome (CO):
On completion of this course students will be able to
1. Demonstrate general processes involved in CAD/CAM and formation of graphical primitives in any non-parametric CAD system.
2. Interpret the process of creation and modifications of 1D entity in parametric CAD software with better logical and mathematical understanding behind it.
3. Apply theoretical conceptions behind parametric modelling of curves, surfaces, and solids in CAD software.
4. Analyse the process of numerical simulations under various structural and thermal loadings along with different boundary conditions using finite element method.
5. Evaluate the technical viability of any product from the view point of manufacturing in the process of CAM and CIM.
6. Build any CNC machine programming with confidence and ease.

*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question

Department & Section	Submission link:
ME	https://classroom.google.com/u/0/w/NDA1NjI0ODYxNjU3/tc/NDU1MTY3NjAyMjgz