

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 CAD data exchange format?
 (a) IGES (b) STEP (c) VGA (d) DXF.
- (ii) Which of the following is most updated display device?
 (a) CRT Display Device (b) LCD Display Device
 (c) OLED Display Device (d) LED Display Device.
- (iii) 3×3 homogeneous transformation matrix for Mirror about a line making angle 45° with X-axis and passing through origin is
 (a) $\begin{bmatrix} 1 & 0 & 0 \\ -1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (b) $\begin{bmatrix} 0 & -1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (c) $\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$ (d) $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$
- (iv) Which one of the following is not a conic?
 (a) Parabola (b) Ellipse (c) Circle (d) NURBS.
- (v) The shape of the Bezier curve is controlled by
 (a) control points (b) knots (c) end points (d) all the above.
- (vi) Which one of the following is not a Synthetic Surface?
 (a) Bezier Surface (b) B-Spline Surface
 (c) Cylindrical Surface (d) Coons Surface.
- (vii) Stiffness matrix of a BEAM element is a
 (a) 3×3 matrix (b) 4×4 matrix
 (c) 2×2 matrix (d) single column matrix.
- (viii) Which of the following is not related with solid modelling technique?
 (a) CSG (b) DDA (c) B-rep (d) Sweep.
- (ix) For CNC milling operation the G-Code 'G33' is used for
 (a) Clockwise Circle Cutting (b) Anti Clockwise Circle Cutting
 (c) Thread Cutting (d) Dwell.

- (x) G40/ G41/ G42 all together consist of
- | | |
|----------------------------|-----------------------------------|
| (a) automatic return group | (b) cutter compensation group |
| (c) units group | (d) active plane Selection group. |

Group – B

2. (a) Compare IGES and STEP graphic exchange formats. [(CO1)(Understand/LOCQ)]
(b) Rasterize a line from (-2, 2) to (5, -4) mm on a display which is mapped to approximately (600 × 400) 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)]
3 + 9 = 12
3. The two ends of a straight-line PQ have coordinates P= (1, 3) and Q= (2, 5). It is to be reflected about a straight line that passes through the points (0, 0.5) and (4, 6). After reflection it is to be rotated by 30° in clockwise direction with respect to the current position of the end 'P'. Write the necessary transformation matrix for the above operations, and determine the new coordinates of the end points of the line. Then schematically represent the line at its initial position as well as at its final position. [(CO2)(Evaluate/HOCQ)]
(9 + 3) = 12

Group – C

4. There are two lines 'L₁' and 'L₂'. 'L₁' is from (-3, -17) to (10, 2) and 'L₂' is from (1, 3) to (7, -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)(Apply/HOCQ)]
(2 + 6 + 4) = 12
5. (a) Mention all the methods of surface representation in CAD. [(CO3)(Remember/LOCQ)]
(b) Write in detail about Constructive Solid Geometry (CSG) method of solid representation. [(CO3)(Explain/IOCQ)]
3 + 9 = 12

Group – D

6. Mention detailed classification of various types of element used in solving structural problems with help of Finite Element Method showing all the elements schematically along with their Nodal Degree of Freedom. [(CO4)(Analyze/IOCQ)]
12
7. Fig.1 shows a beam imposed with point load and distributed load. Determine global stiffness matrix for this problem and find out vertical displacements of the beam at point B and midpoint of CD. Consider: E = 210 MPa, MOI(I) = 1600 mm⁴, l = 3 m, F = 100 N and q = 200 N/m. [(CO4)(Analyse/HOCQ)]

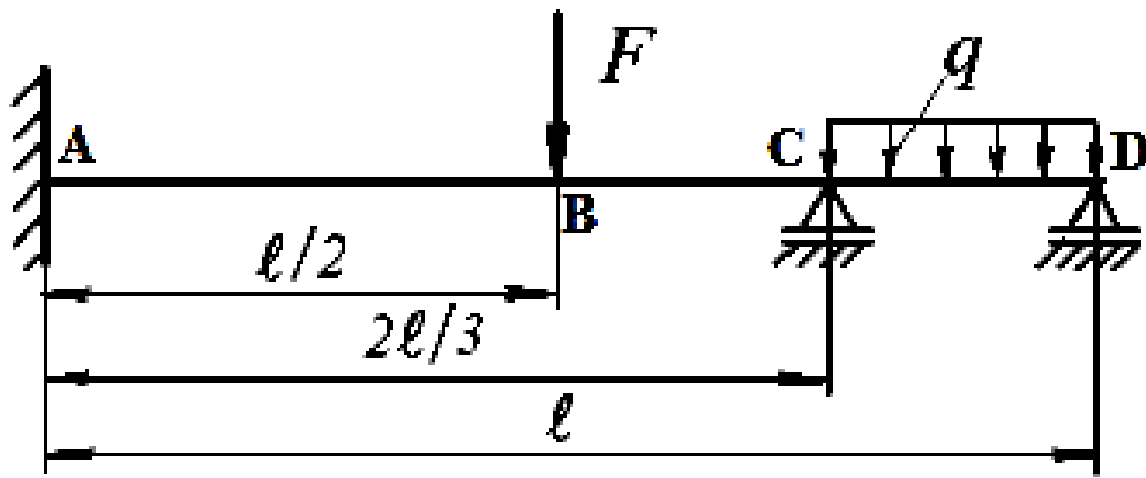


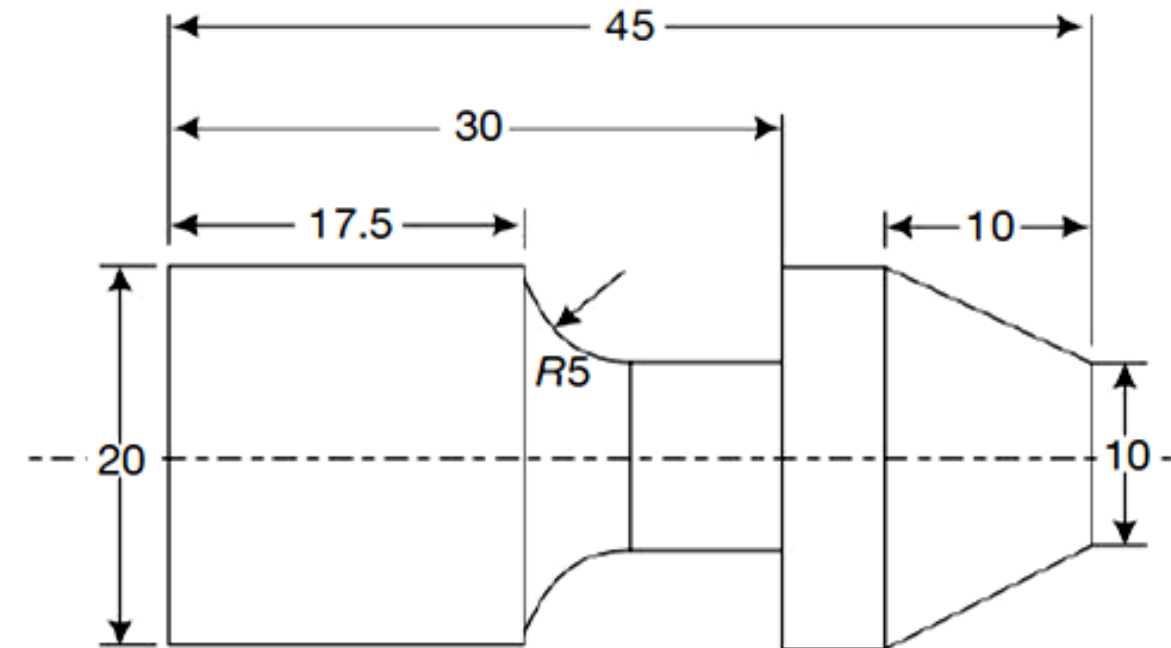
Fig.1

(5 + 7) = 12

Group – E

8. Write a detailed note on Computer Integrated Manufacturing process accompanying with suitable figures and examples. [[CO5](Explain/IOCQ)]
12

9. It is required to do a CNC turning operation to manufacture a component, drawing of which is given in Fig.2 below. This part is to be machined from a rolled stock of 20 mm diameter. Prepare the process plan and represent them in tabular form and then write down a complete NC program to execute the machining in CNC turning machine. [[CO6](Evaluate/IOCQ)]



(All dimensions in mm)

Fig.2

(3 + 9) = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	6.25	56.25	37.5

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.