Duration: 3hrs **Max Marks: 80**

N.B. : (1) Question No 1 is Compulsory.
(2) Attempt any three questions out of the remaining five.
(3) All questions carry equal marks.
(4) Assume suitable data, if required and state it clearly.

1 Attempt any FOUR **[20]**

a What is the significance of CAD/CAM in the product life cycle, and how does it contribute to the design process?

b What are the principles behind Constructive Solid Geometry (CSG) and Boundary Representation (B-Rep) in solid modeling? Provide example of their application.

c What is the Homogeneous Coordinate system, and how does it facilitate geometric transformations in computer graphics?

d What are the transformation matrices for Pure

i) 2D rotation about origin, ii) 2D mirroring @ X axis, iii) 2D shearing @ X axis, iv) 3D rotation @ X axis, v) 3D scaling with Sx, Sy & Sz as respective Scaling factors.

e Explain the components and functionalities of a machining center.

f Explain the socio-economic aspects of Virtual Manufacturing. How does Virtual Manufacturing contribute to cost reduction, product innovation, and sustainable production practices?

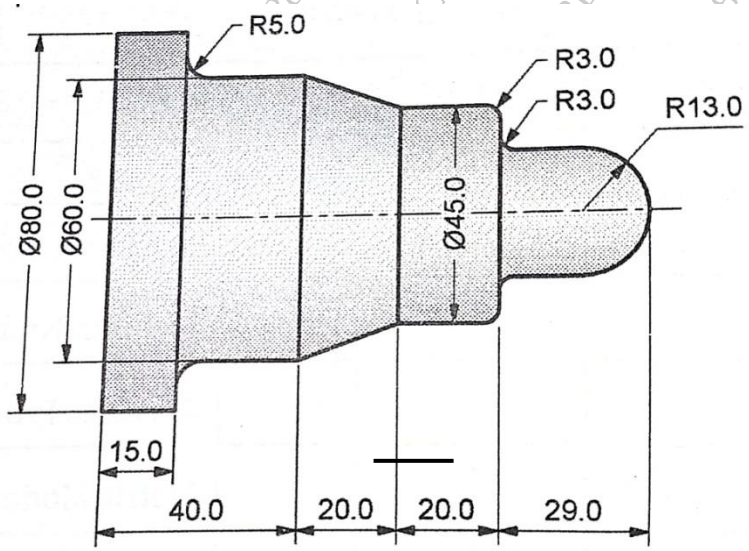
2 a Reflect a triangle ABC, A(2,4), B(4,6) & C(2,6) about a line 2y - x - 4 = 0. Determine (i) the concatenated transformation matrix and (ii) coordinates of the vertices for the reflected triangle. **[10]**

b Explain the characteristics of the Bezier curve and plot a Bezier curve having control points as **P_0 (1, 0), P_1 (3, 3), P_2 (6, 3) and P_3 (8, 1)**. Take a step size of **0.2.** **[10]**

3 a Explain the principles underlying Computed Tomography (CT), Cone beam CT (CBCT), and Magnetic Resonance Imaging (MRI). How do these techniques differ in terms of their applications in medical imaging? **[10]**

b Explain the significance of medical scan data in biomedical modeling. How are medical scan data acquired and processed for further analysis? **[10]**

4 a Write a manual part program for the finishing the following component as shown in figure. Illustrate the meaning of each code used in the program and the tool movement by showing the tool path.Use the diametral format for programming. **[10]**



Assume suitable data if needed.

b In the context of manual part programming, **[10]**

Explain-

i) At least 5 Standard G and M codes need to be included in the beginning and ending of any general program.

ii) A sample manual program using at least any one canned cycle.

5 a Explain the Selective Laser Sintering (SLS) process, including its working principle and key components. How does SLS compare to other additive manufacturing techniques in terms of material compatibility and complexity of parts produced? **[10]**

b Compare SLA, SLS, 3D Printing, FDM, and LOM in terms of their working principles and capabilities. **[10]**

6 a Define Virtual Manufacturing and discuss its significance in the modern industrial landscape. What are the primary objectives and scope of Virtual Manufacturing? **[10]**

b 1) Discuss the potential challenges and limitations of Virtual Manufacturing. **[10]**

2) Explain the concept of Feature-based Modeling and Constraint-based Modeling in CAD/CAM systems.

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