

The figures in the margin indicate full marks

Make appropriate assumptions for any missing data.

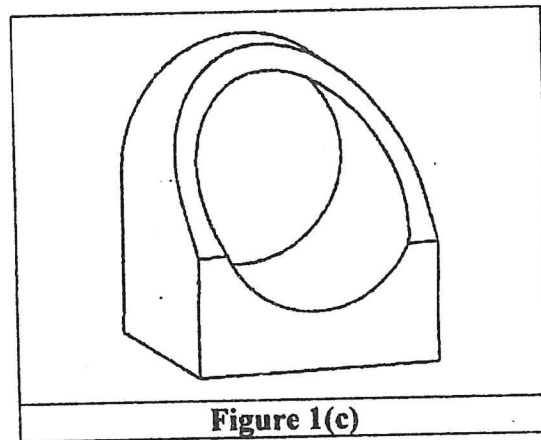
USE SEPARATE SCRIPTS FOR EACH SECTION

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SECTION - A

There are **FOUR** questions in this section. Answer any **THREE** questions

1. (a) Identify the drawbacks of the Phal and Beitz model and the Ohsuga model, and explain how these drawbacks can be addressed. (10)
- (b) Explain the Euler-Poincare formula using a simple 3D model. (10)
- (c) Develop the solid model shown in Figure 1(c) using the method of Constructive Solid Geometry (CSG) with the appropriate Boolean expression. (15)



2. (a) What do you understand by NC and CNC? Mention the benefits of CNC machines over NC machines. (4+6=10)
 - (b) Briefly describe three types of motion control and provide appropriate applications for each. (10)
 - (c) A ball end mill cutter is being used for free-form surface machining — justify its use. How does the stepover distance between two consecutive passes affect the surface finish of the machined part? (7+8=15)
3. (a) Explain the difference between accuracy and repeatability, as well as their importance in CNC machining. (10)
 - (b) Write a G code for the part shown in Figure 3(b). Show only the tool movement in different axes. (10)

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Contd.... for Q. No. 3

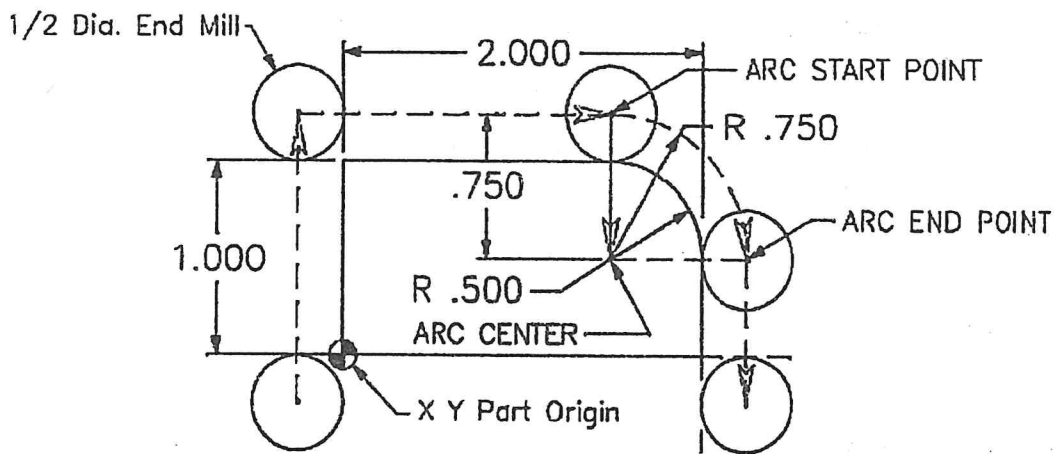


Figure 3(b)

- (c) Explain the tool positioning modes — absolute positioning and incremental positioning — with an example. Discuss the benefits and limitations of absolute positioning compared to incremental positioning. (10+5=15)
4. (a) "G 28" is a "Non-modal" command — justify. (5)
(b) Write a G-code block to machine a complete circle using the R command. (5)
(c) Discuss the advantages and disadvantages of the Collect-and-Chuck Tool Holder compared to the End Mill Tool Holder. *collet* (10)
(d) Briefly describe three types of automatic tool changers used in CNC machining centers. (15)

SECTION - B

There are **FOUR** questions in this section. Answer any **THREE** questions.

5. (a) "SolidWorks is a graphical design software which can be classified both as an image-space graphics and an object-space graphics." — Do you support this statement? Explain your opinion. (10)
(b) "In the case of vector generation, the number of lines depends on tolerances, i.e., the maximum allowable deviation from the true curve." — Explain the statement with the help of a circle. (10)
(c) Suppose a curve was previously drawn using a Hermite cubic polynomial with the points $P_0 = (1, 1)$, $P_1 = (6, 5)$, $P'_0 = (0, 4)$, and $P'_1 = (4, 0)$. (10+5=15)

Using the Bezier curve formulation:

- (i) Find the coordinate values at $u = 0, 0.25, 0.5, 0.75, 1$.
(ii) Draw the curve and its control polygon.

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- 6. (a) Discuss the structure and functionality of A Simple Data Structure that supports geometric entities. How does this structure facilitate entity addition, deletion, and modification? (15)
- (b) Explain the primary sections of an IGES file. How do they contribute to the structured transfer of data within the IGES format? (10)
- (c) Define a point and a circle to model geometric entities using EXPRESS language. (10)

- 7. (a) Consider the mirroring of points through a line at an angle of 30° to the x-axis with its origin at $x = 32, y = 24$. The points are located as shown in Fig. 7(a). Conduct object transformation for the point $x = 50, y = 79$. (15)

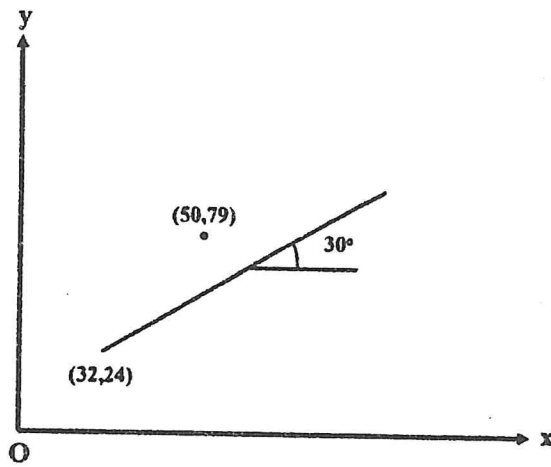


Fig 7(a)

- (b) Discuss the requirements for a data structure of CAD systems to support interactive modeling. (10)
- (c) Explain with suitable examples ^{of} the facilities that are typically provided for the manipulation of CAD models. (10)

- 8. (a) What do you understand by "Joint Space" and "World Space" methods of representing the position and orientation of a robot manipulator's end of arm? Explain with the help of "OO" and "RR" robots. (8)

(12)

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Contd.... for Q. No. 8

(b) Given the world coordinates for the TRL:R robot in Fig. 8(b) as $x = 280$ mm, $y = 0$, $z = 475$ mm and $\alpha = 40^\circ$; and given that the links have values $L_0 = 0$, $L_1 = 376$ mm, λ_3 has a range from 180 mm to 325 mm, determine the joint values $\theta_1, \theta_2, \theta_4, \lambda_3$.

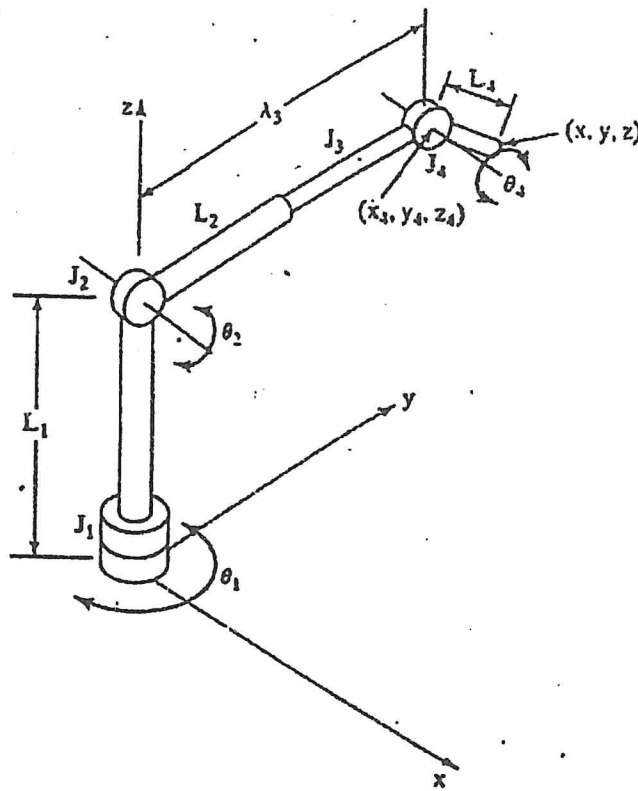


Fig 8(b)

(c) How the work volume of a robot manipulator is defined? Draw work volume for five basic robot configurations.

(10)

(d) List the advantages of FANUC controller for a robot.

(5)

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List of G-code for CNC Milling/Turning Operations

G-code	Description
G00	Rapid traverse
G01	Linear interpolation
G02	Clockwise circular interpolation
G03	Counterclockwise circular interpolation
G20	Inch data input
G21	Metric data input
G28	Automatic return to the reference point

G-code	Description
G40	Tool (nose) radius compensation cancel
G41	Tool (nose) radius compensation left
G42	Tool (nose) radius compensation right
G54-59	Workpiece coordinate system 1-6 selection
G90	Absolute command programming
G91	Incremental command programming
G92	Zero offset setting

G-code	Description
G50	Maximum spindle speed command
G80	End of shape designation
G81	Start of longitudinal shape designation
G82	Start of traverse shape designation

G-code	Description
G85	Call for rough bar turning cycle
G87	Call for finishing turning cycle
G96	Constant cutting speed
G97	Fixed RPM

List of M-code for CNC Milling/Turning Operations

M-code	Description
M02	End of program
M03	Spindle clockwise
M04	Spindle counterclockwise
M05	Spindle stop

M-code	Description
M06	Tool change
M08	Coolant on (spray)
M09	Coolant off
M30	End of program