GUJARAT TECHNOLOGICAL UNIVERSITY
DEPARTMENT OF ROBOTICS & AUTOMATION
L D COLLEGE OF ENGINEERING, AHMEDABAD
AUTOMATED MANUFACTURING (3172010)
B. E. VII SEM

EXPERIMENT NO: DATE:

INTRODUCTION TO CNC MACHINES

1. State the main components of a CNC machine. Write down the primary function of each.
2. What is the function of the spindle in a CNC machine?
3. What is backlash in CNC axes, and how can it affect machining accuracy?
4. Explain the difference between open-loop and closed-loop control systems in CNC machines.
5. A traditional workshop uses manual lathes, and milling machines. They are planning to upgrading the manual lathes and milling machines to CNC machines to improve productivity and reduce human error.

    a) Compare the hardware differences between manual machines and CC machines.
    b) How does the transition to CNC machine impact productivity and operational efficiency of the work shop?
    c) What challenges might the workshop face in transitioning to CNC technology, and how can they address them?

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EXPERIMENT NO: DATE:

FUNDAMENTALS OF PART PROGRAMMING

1. What is CNC part programming, and why is it important in modern manufacturing?
2. What is G-code, and how is it used in CNC machines? Provide examples of basic G-code commands.
3. What is the difference between absolute programming and incremental programming in CNC?
4. List and explain three common M-codes used in CNC part programming.
5. What is the significance of feed rate and spindle speed in CNC machining? How are they specified in a part program?
6. What is the function of canned cycles in CNC programming? Provide an example of a canned cycle and explain its syntax.
7. How do you use tool length and radius compensation in CNC programming? Why is it necessary?

8. **Linear Interpolation:** A CNC machine operator is tasked with cutting a rectangular pocket on a metal workpiece. The dimensions of the pocket are 100 mm × 50 mm, with a depth of 10 mm.

Questions:

- What G-code command is used for linear interpolation, and how would you use it to cut the rectangular pocket?
- How do absolute (G90) and incremental (G91) programming modes affect the coordinates specified for linear interpolation?
- Write the part program for the rectangular pocket using linear interpolation.
- If the tool leaves marks at the corners of the pocket, how would you modify the feed rate to improve the finish?
- How can you ensure that the cutting depth is achieved incrementally without overloading the tool?

9. **Circular Interpolation**: A CNC operator is instructed to machine an arc of 90° with a radius of 30 mm on a flat aluminium plate. The arc starts at the coordinate (X20, Y20) and ends at (X50, Y50).

   Questions:

   - How do you decide whether to use G02 (clockwise) or G03 (counterclockwise) for programming the arc?
   - What additional parameters are needed for circular interpolation, and how are they specified in the program?
   - Write the CNC program to machine the arc.
   - What precautions should you take to avoid tool chatter when machining the arc?
   - How would the program change if the arc needed to cover 180° instead of 90°?

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EXPERIMENT NO: DATE:

MILLING MACHINE CENTER

1. What are the most common G-codes and M-codes used in CNC milling? Provide examples.
2. What is the purpose of tool length compensation (G43 and G44)?
3. Explain the difference between absolute positioning (G90) and incremental positioning (G91). When would you use each?
4. What is the significance of feed rate (F) and spindle speed (S) in a CNC program? How do you determine appropriate values for each?
5. What is the function of the G00 and G01 commands in part programming?
6. How would you program a simple rectangular path using G01? Provide an example.
7. What is the purpose of G02 (clockwise interpolation) and G03 (counterclockwise interpolation)? How are these used in creating circular features?
8. Write a basic CNC program to drill a single hole at a specific location using a canned cycle (G81).
9. What are the parameters required to define a circular arc in part programming? (e.g., start point, endpoint, radius, or center coordinates).
10. What is the purpose of the G17, G18, and G19 codes, and how do they define the machining plane?
11. Write a CNC program to mill a rectangular pocket with dimensions 100 mm × 50 mm and a depth of 10 mm.
12. Write a program to machine a slot with dimensions 20 mm × 100 mm, with a depth of 5 mm, using incremental positioning (G91).

13. Program a part with both climb and conventional milling operations. Explain your choice for each section.

14. Drilling a Hole Pattern

A CNC operator needs to drill a circular hole pattern consisting of 6 holes, evenly spaced, with a radius of 50 mm. The holes have a depth of 5 mm and are drilled into a steel workpiece.

Questions:

1. How would you calculate the coordinates for each hole in the circular pattern?
2. Write a CNC program to drill the hole pattern using canned cycles (G81).
3. What is the difference between absolute (G90) and incremental (G91) positioning when drilling the holes?

15. Slot Milling

A slot of 10 mm width and 50 mm length needs to be milled into a workpiece, with a depth of 5 mm. The slot starts at coordinates (X20, Y20) and runs parallel to the X-axis.

Questions:

1. Write a CNC program for milling the slot using a straight end mill.
2. How can you use multiple Z-axis passes to achieve the required depth without damaging the tool?
3. What tool diameter would you select for this slot, and why?

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TURNING CENTER

1. What is CNC turning, and how is it different from CNC milling?
2. What is the purpose of the following commands in CNC turning?
3. What is a dry run, and why is it performed before actual machining?
4. How do you use the G96 constant surface speed command in turning, and why is it useful?
5. What is the purpose of the G71 rough turning cycle, and how is it programmed?
6. Write a CNC turning program to reduce the diameter of a workpiece from 60 mm to 50 mm over a length of 100 mm.
7. Write a CNC program to create a step shaft with diameters of 50 mm, 40 mm, and 30 mm, with step lengths of 40 mm, 30 mm, and 20 mm, respectively.
8. **Facing Operation**

   A machinist needs to perform a facing operation on a cylindrical workpiece with a diameter of 50 mm and a length of 100 mm to prepare a flat surface.

   Questions:

   1. What G-code is used to perform a facing operation, and how would you define the tool path?
   2. Write a basic CNC program for the facing operation using absolute coordinates (G90).
   3. What spindle speed (S) and feed rate (F) would you recommend for this operation?
   4. If the tool leaves marks on the surface, what changes would you make to improve the finish?
   5. How does the choice of insert geometry affect the facing operation?
9. **Turning to a Specific Diameter**

   A cylindrical workpiece with an initial diameter of 60 mm needs to be reduced

to a diameter of 50 mm along a length of 100 mm.

Questions:

1. What G-code commands are used for turning operations in CNC lathe programming?
2. Write a CNC program to perform the turning operation, ensuring the depth of cut is taken incrementally.
3. How do you determine the optimal depth of cut and feed rate for this material?
4. What is the role of G96 (constant surface speed) and G97 (fixed spindle speed) in this operation?
5. If the final diameter is not accurate, what steps would you take to troubleshoot and correct the program?

10. Taper Turning

A machinist is tasked with creating a tapered section on a workpiece, reducing the diameter from 40 mm to 20 mm over a length of 60 mm.

Questions:

1. How would you use G01 linear interpolation to program the taper?
2. Write a CNC program to machine the tapered section using absolute positioning (G90).
3. How does the choice of cutting tool angle affect the accuracy of the taper?
4. What spindle speed and feed rate adjustments would you make for taper turning?
5. How can you verify the dimensions of the taper after machining?

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GROUP TECHNOLOGY

Q.1 List the primary condition to implement the Group Technology.

Q.2 Explain the concept of the Composite part.

Q.3 Apply the rank order clustering technique to the part machine incidence matrix in the following table to identify logical part families and machine groups. Parts are identified by letters and machines are identified numerically.

	Parts					
Machines	A	B	C	D	E	F
1	1				1	
2				1		1
3	1	1				
4			1	1		
5		1			1	
6			1	1		1

Q.4 Four machines used to produce a family of parts are to be arranged into GT cell. The From-To data for the parts processed by the machines are shown in the table below. (a) Determine the most logical sequence of machines for this data using Hollier Method 1 and Hollier Method 2. (b) Construct the flow diagram for the data, showing where and how many parts enter and exit the system. (c) Compute the percentage of in-sequence moves and the percentage of back tracking moves in the solution. (d) Develop a feasible layout plan for the cell.

	To			
From	1	2	3	4
1	0	10	0	40
2	0	0	0	0
3	50	0	0	20
4	0	50	0	0

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FLEXIBLE MANUFACTURING SYSTEM

Q.1 Explain the working of AS/RS.

Q.2 Define the different types of Flexibility in manufacturing. List the factors on which this flexibility depends.

Q.3 Differentiate clearly a dedicated FMS and random order FMS.

Q.4 What is forward and backward kinematics in Robots.

Q.5 State the differences between powered Leadthrough and manual Leadthrough programming methods.

Q.6 Draw the different types of joints used in robots. State the application of each.

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ROBOTICS

1. What is a robot?
2. What are the main components of a robot?
3. What are some common types of robots?
4. How do robots receive and process information?
5. What industries commonly use robots today?
6. What role do robots play in manufacturing?
7. What are the different types of sensors used in robots?
8. What is the role of actuators in a robot?