<u>COURSE FILE</u>

CNC TECHNOLOGY

(Subject Code: C414)

IV Year, I Sem B.TECH. (MECHANICAL ENGINEERING)

Submitted to

DEPARTMENT OF MECHANICAL ENGINEERING

BY

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NAWAB SHAH ALAM KHAN COLEEG OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

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Contents

3. VISION AND MISSION OF THE INSTITUTE

VISION

To impart quality technical education with strong ethics, producing technically sound engineers capable of serving the society and the nation in a responsible manner.

MISSION

M1: To provide adequate knowledge encompassing strong technical concepts and soft skills thereby inculcating sound ethics.

M2: To provide a conducive environment to nurture creativity in teaching- learning process.

M3: To identify and provide facilities which create opportunities for deserving students of all communities to excel in their chosen fields.

M4: To strive and contribute to the needs of the society and the nation by applying advanced engineering and technical concepts.

4. VISION AND MISSION OF MECHANICAL ENGINEERING DEPARTMENT

VISION

To achieve excellence in Mechanical Engineering by imparting technical and professional skills along with ethical values to meet social needs via industrial requirements.

MISSION

M1: To offer quality education with the supportive facilities to produce efficient and competent engineers through industry-institute interaction.

M2: To prepare the students with academic excellence, professional competence, and ethical behaviour for a lifelong learning.

M3: To inculcate moral & professional values among the students to cater the needs of the society and environment.

5. PROGRAMME EDUCATIONAL OBJECTIVES (PEOs)

- **PEO 1:** Graduates will apply their engineering knowledge and problem solving skills to design mechanical systems and processes.
- **PEO 2:** Graduates will embrace leadership skills at various roles in their career and establish excellence in the field of Mechanical Engineering.
- **PEO 3:** Graduates will provide engineering solutions to meet industrial requirements there by full fill societal needs.

6.1 PROGRAM OUTCOMES (POs)

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate review research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

6.2 PROGRAM SPECIFIC OUTCOMES (PSOs)

- **PSO-1:** Implement new ideas on product design and development with the help of modern computer aided tools, while ensuring best manufacturing practices
- **PSO-2:** Impart technical knowledge, ethical values and managerial skills to make successful in career.
- **PSO-3:** Develop innovative attitude, critical thinking and problem solving approach for any domains of mechanical engineering

7. Syllabus

Course Code	Course Title				Core/Elective
C 414	CNC TECHNOLOGY				Professional Elective – III
Prerequisite	Contact Hours per week				Credits
	L	T	P	D	
	3	0	0	0	3

UNIT - I

Features of NC machines: fundamentals of numerical control, advantage of NC systems, classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems, features of NC Machine tools, design consideration of NC machine tool, methods of improving machine accuracy.

CNC Machine elements: machine structures - Guide ways - feed drives-spindles- spindle bearings-measuring systems- tool mentoring systems.

UNIT - II

Tooling for CNC machines: interchangeable tooling system, preset and qualified tools, coolant fed tooling system, modular fixturing, and quick-change tooling system, automatic head changers.

NC part programming: manual Programming-Basic concepts, point to point contour programming, canned cycles, parametric programming.

UNIT - III

Computer-Aided Programming: General information, APT programming, Examples Apt programming problems (2D machining only). NC programming on CAD/CAM systems, the design and implementation of post processors. Introduction to CAD/CAM software, Automatic Tool Path generation.

UNIT - IV

DNC Systems and Adaptive Control: Introduction, type of DNC systems, advantages and disadvantages of DNC, adaptive control with optimization, adaptive control with constraints, Adaptive control of machining processes like turning, grinding.

UNIT - V

Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory, counters, timers and serial data I/O interrupts selection of Micro Controllers, Embedded Controllers, Applications and Programming of Micro Controllers.

Programming Logic Controllers (PLC'S): Introduction, Hardware components of PLC, system, basic structure, principle of operations, Programming mnemonics timers, Internal relays and counters, Applications of PLC'S in CNC Machines.

TEXT BOOKS:

1. Computer Control of Manufacturing Systems/ Yoram Koren/ Mc Graw Hill
2. CNC Programming: Principles and Applications /Mattson/ Cengage

REFERENCE BOOKS:

1. Machining Tools Hand Book Vol 3/ Manfred Weck , John Wiley Mechatronics HMT/ Mc Graw Hill .
2. Machining and CNC Technology / Michael Fitzpatrick / Mc Graw Hill.

8.1 COURSE OBJECTIVES

- Importance of CNC machines.
- Understand the fundamentals of it.
- Learning various methods of tooling the CNC machines.
- Various controlling methods,
- Learning the part programming

8.2 COURSE OUTCOMES

S. No	Description
CO1	Describe and Understand the different types of Numerical Control (NC) system and structure (their components) of the Computer Numerical Control (CNC).
CO2	Learn different tooling method and prepare types of programming for Numerical Control (NC) system and Automatically Programmed Tool (APT) part programming.
CO3	Learn Direct Numerical Control (DNC) system with proper use of Adaptive Control with optimization and constraints for turning and grinding.
CO4	Learn types of micro controller and Programmable Logic Controller (PLCs) system sue in CNC machines.

9. MAPPING OF COURSE OUTCOMES WITH PROGRAM OUTCOMES

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	1	3	2	-	-	-	-	1	1	1
CO2	3	2	3	2	3	-	-	-	-	2	1	1
CO3	3	3	2	3	-	-	-	-	-	-	1	1
CO4	2	2	2	2	2	-	-	-	-	-	1	1

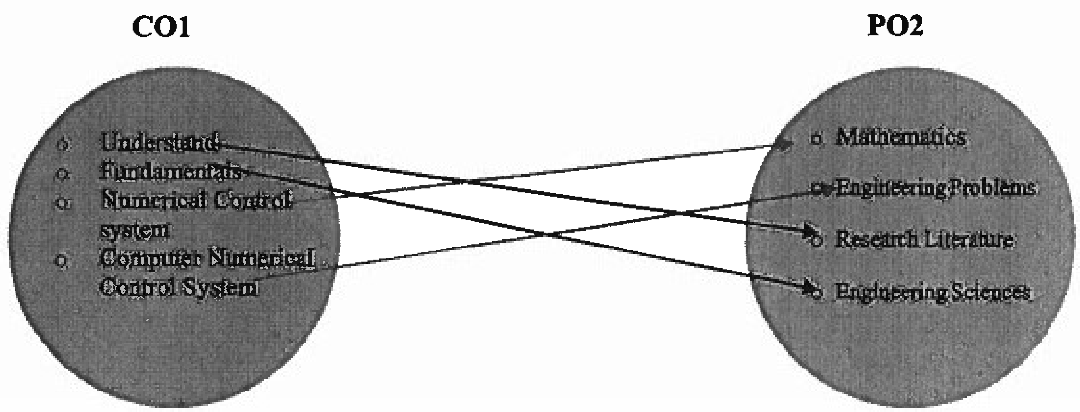
CO to PO mapping with justification:

Probability (CO# to PO#) =

< 0.25 = No Correlation
> 0.25 and <= 0.50 = 1
>0.50 and <= 0.75 = 2
>0.75 and <= 1.00 = 3

CO1: Describe and Understand the different types of Numerical Control (NC) system and structure (their components) of the Computer Numerical Control (CNC).

PO2: Problem analysis: Identify, formulate review research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.



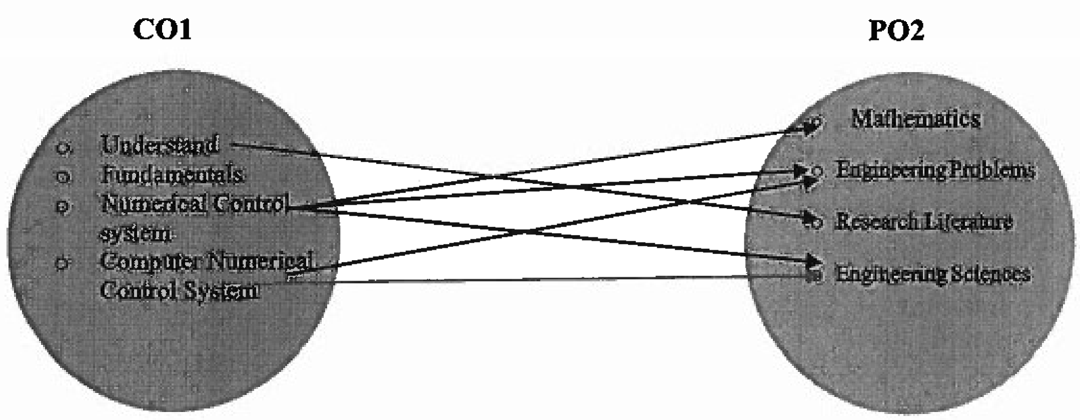
Probability of CO# to PO# $= P(K_1) + P(K_2) + P(K_3) + P(K_4)$

$= ¼ + ¼ + ¼ + ¼ = 1$

Correlation - CO1 to PO1 = 3

CO1: Learn different tooling method and prepare types of programming for Numerical Control (NC) system and Automatically Programmed Tool (APT) part programming.

PO2: Problem analysis: Identify, formulate review research literature and analyze complex engineering problems reaching substantiated conclusions using first principle of mathematics, natural science and engineering science.



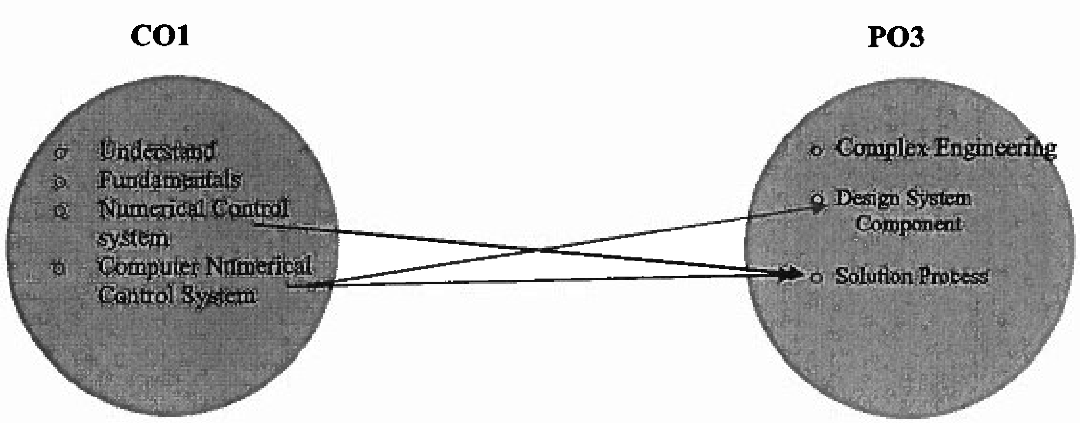
Probability of CO# to PO# $= P(K_1) + P(K_2) + P(K_3) + P(K_4)$

$= ¼ + 0 + ¼ + ¼ = 0.75$

Correlation - CO1 to PO1 = 2

CO1: Describe and Understand the different types of Numerical Control (NC) system and structure (their components) of the Computer Numerical Control (CNC).

PO3: Design/development of solutions: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.



Probability of CO# to PO# $= P(K_1) + P(K_2) + P(K_3) + P(K_4)$

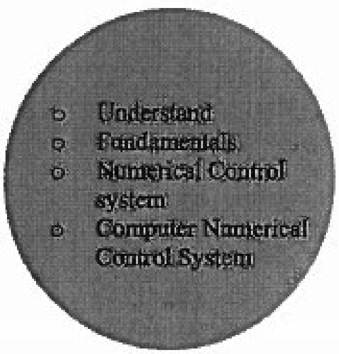
$= ¼ + 0 + 0 + ¼ = 0.5$

Correlation - CO1 to PO1 = 1

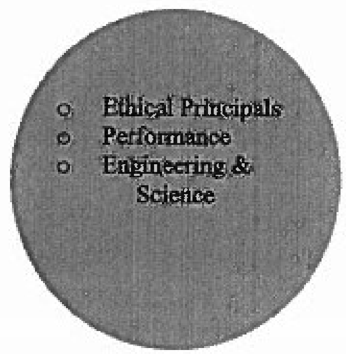
CO1: Describe and Understand Numerical Control (NC), Computer Numerical Control (CNC) and Direct Numerical Control (DNC) systems.

PO8: Ethics: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

CO1



PO8



Probability of CO# to PO# $= P(K_1) + P(K_2) + P(K_3) + P(K_4)$

$= 0 + 0 + 0 + 0 = 0.5$

Correlation - CO1 to PO1 = 0

10. . Pre-requisite:

The learner is expected to have the following:

- Engineering or other technical degree or equivalent experience.
- Knowledge of the proper use of basic hand tools and precision measuring instruments, including calipers and micrometers.
- Some manual machining experience is helpful but not required.
- Knowledge of Solid works is a pre-requisite or co-requisite for this course.

11. Lecture Schedule with methodology being using / adopted

S. No.	Lecture No.	Topic	Regular/ Additional	Teaching aids used PPT/ OHP/ BB	Remarks
		UNIT-I			
1	1	Introduction	Regular	BB	
2	2	Fundamentals of numerical control, advantage of NC systems,	Regular	BB	
3	3, 4	Classification of NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems,	Regular	BB	
4	5	Features of NC Machine tools, design consideration of NC machine tool, methods of improving machine accuracy.	Regular	BB	
5	6, 7	CNC Machine elements: machine structures - Guide ways - feed drives-spindles- spindle bearings-	Regular	BB	
6	8	Measuring systems- tool mentoring systems. Any additional/remaining topics, discussing objective and previous year questions	Regular	BB	
		UNIT-II			
7	9, 10	Tooling for CNC machines: interchangeable tooling system, preset and qualified tools, coolant fed tooling system,	Regular	BB	
8	11	Modular featuring, and quick-change tooling system, automatic head changers.	Regular	BB	
9	12	NC part programming: manual programming-Basic concepts	Regular	BB	
10	13, 14	Point to point contour programming, canned cycles, parametric programming.	Regular	BB	
11	15	Preparing part programs for Example parts	Regular	BB	
12	16	Any additional/remaining topics, discussing objective and previous year questions	Regular	BB	

		Controllers.	Regular		
28	40, 41	Programming Logic Controllers (PLC'S): Introduction, Hardware components of PLC,	Regular	BB	
29	42	Basic structure, principle of operations, Programming mnemonics timers,	Regular	BB	
30	43, 44	Internal relays and counters, Applications of PLC'S in CNC Machines.	Regular	BB	
31	45	Any additional/remaining topics, discussing objective and previous year questions	Regular	BB	

12. Lecture schedule

Lecture No.	Week No.	TOPIC	Course Learning outcomes	Reference
		UNIT – 1		
1.	1	Introduction and features of NC machines	**Know** about NC machines	Ref. Book No. 1,2
2.		Fundamentals of numerical control machine and advantage of NC systems	**Know** about principal operation of NC machine	
3.		Point to point, NC and CNC, incremental and absolute	**Know** about CNC operating system	
4.		Open and closed loop systems, features of NC Machine tools	**Gathering** Knowledge loop system.	
		Tutorial / Bridge Class # 1		
5.	2	Design consideration of NC machine tool, methods of improving machine accuracy.	**Know** about NC machines tooling methods.	
6.		CNC Machine elements: machine structures - Guide ways - feed drives	**Gathering** Knowledge of CNC machine.	
7.		Spindles - spindle bearings-measuring systems-tool mentoring systems.	**Know** the spindle and tool mentoring syatem	
8.		Revision		
		UNIT-2		
9.	3	Introduction of tooling for CNC machines, interchangeable tooling system	**Know** about interchangeable tooling system.	Text Book No. 1,2
10.		Preset and qualified tools, coolant fed tooling system	**Know** about coolant fed tooling system.	
11.		Modular fixturing, and quick-change tooling system	**Understanding** the Principles of quick change tooling system	
12.		***Mock Test – I***		
13.	4	Automatic head changers	**Gathering** Knowledge about Automatic head changers.	
14.		Introduction of NC part programming, manual programming-Basic concepts,	**Gathering** Knowledge about NC part programming.	
15.	5	Point to point contour programming,	**Gathering** Knowledge about canned cycles,.	
16.		canned cycles, parametric programming.	**Gathering** Knowledge about parametric programming	
17.		***Tutorial / Bridge Class # 2***		

		UNIT-3		
18.	6	Introduction of Computer-Aided Programming	**Gathering** Knowledge about Computer-Aided Programming	
19.		General information, APT programming, Examples Apt programming problems (2D machining only)	**Know** about APT programming	
20.		NC programming on CAD/CAM systems,	**Know** about NC programming	
21.		***Tutorial / Bridge Class # 3***		
		Mid-I Examinations (Week 9)		
22.	7	The design and implementation of post processors	**Gathering** Knowledge about post processors	
23.		Introduction to CAD/CAM software,	**Know** about CAD/CAM systems	
24.		Automatic Tool Path generation.	**Gathering** Knowledge about Automatic Tool Path generation.	
25.		***Tutorial / Bridge Class # 4***		
		UNIT- 4		
26.	8	Introduction of DNC Systems and Adaptive Control	**Gathering** Knowledge about Adaptive Control system	Text Book No. 1,2
27.		Principal of DNC system	**Know** about operating principal of DNC Systems	
28.		Type of DNC systems, advantages and disadvantages of DNC,	**Know** about different types of DNC Systems	
29.		***Tutorial / Bridge Class # 5***		
30.	9	Adaptive control with optimization, adaptive control with constraints,	**Gathering** Knowledge about Adaptive control with optimization	
31.		Adaptive control of machining processes like turning,	**Know** about Adaptive control of machining	
32.	10	Adaptive control of machining processes like grinding.	**Know** about Adaptive control of machining	
33.		***Tutorial / Bridge Class # 6***		
		UNIT-5		
34.	11	Micro Controllers: Introduction, Hardware components, I/O pins, ports, external memory	**Gathering** Knowledge about Micro Controllers Hardware components	Ref. Book No. 1,2
35.		Counters, timers and serial data I/O interrupts selection of Micro Controllers,	**Know** about Counters, timers and serial data of Micro Controllers	
36.	12	Embedded Controllers	**Know** about Embedded Controllers	
37.		Applications and Programming of Micro Controllers.	**Gathering** Knowledge about Applications and	

			Programming of Micro Controllers.	
38.		***Tutorial / Bridge Class # 7***		
39.	13	Programming Logic Controllers (PLC'S)	**Gathering** Knowledge about Programming Logic Controllers	Ref. Book No. 1,2
41.		Introduction, Hardware components of PLC,	**Know** about Hardware components of PLC	
42.		Basic structure, principle of operations, Programming mnemonics timers,	**Gathering** Knowledge about Basic structure, principle of operations	
43.		***Tutorial / Bridge Class # 8***		
44.	14	Internal relays and counters, Applications of PLC'S in CNC Machines.	**Know** about Internal relays and counters	Ref. Book No. 1,2
45.		***Mock Test – I***		
46.		Any additional/remaining topics, discussing objective and previous year questions	**Know** about remaining topics	
47.		***Tutorial / Bridge Class # 9***		
48.	15	Revision		
49.		Revision		
50.		Revision		
		Mid-II Examinations (Week 16)		

UNIT – I

Features of NC machines

Introduction:

After the Second World War, there was a big spurt in the design and development of aerospace products like satellites, launch vehicles, civil and military aircraft etc. The hydraulic copying and electrical program controlled machines used at that time could not meet the manufacturing challenges posed by the complex aerospace designs. The manufacturing engineers were therefore looking for a better way of automating the machining operations. Numerical control (NC) was developed in early 50's to meet the critical requirements of aerospace Industry. Many components used in aircraft and space vehicles are machined from solid raw materials, often involving removal of considerable stock and requiring several hundred positioning movements of the machine tool slides. Manual operation under these circumstances is not only tedious but also less efficient and unproductive. Often the part after several hours of machining is liable to be rejected due to machining errors.

Many of the achievements in computer-aided design and manufacturing have a common origin in numerical control (abbreviated NC). The conceptual framework established during the development of numerical control is still undergoing further refinement and enhancement in today's CAD/CAM technology. It is appropriate that we devote a major part of this book to the subject of NC.

Fundamentals of numerical control

Computer numerical control (CNC) machining is a type of manufacturing process that involves pre-programmed computer software that controls the movement of factory tools and machinery.

An operational numerical control system consists of the following three basic components:

1. Program of instructions
2. Controller unit, also called a machine control unit (MCU)
3. Machine tool or other controlled process

The general relationship among the three components is illustrated in Figure 7.1. The program of instructions serves as the input to the controller unit, which in turn commands the machine tool or other process to be controlled. We will discuss the three components in the sections below.

Program of instructions:

The program of instructions is the detailed step-by-step set of directions which tell interaction

- Smaller footprint: Due to the fact that several machines are fused into one.

On the other hand, the main disadvantages of NC systems are

- Relatively higher cost compared to manual versions
- More complicated maintenance due to the complex nature of the technologies
- Need for skilled part programmers.

The above disadvantages indicate that CNC machines can be gainfully deployed only when the required product quality and average volume of production demand it.

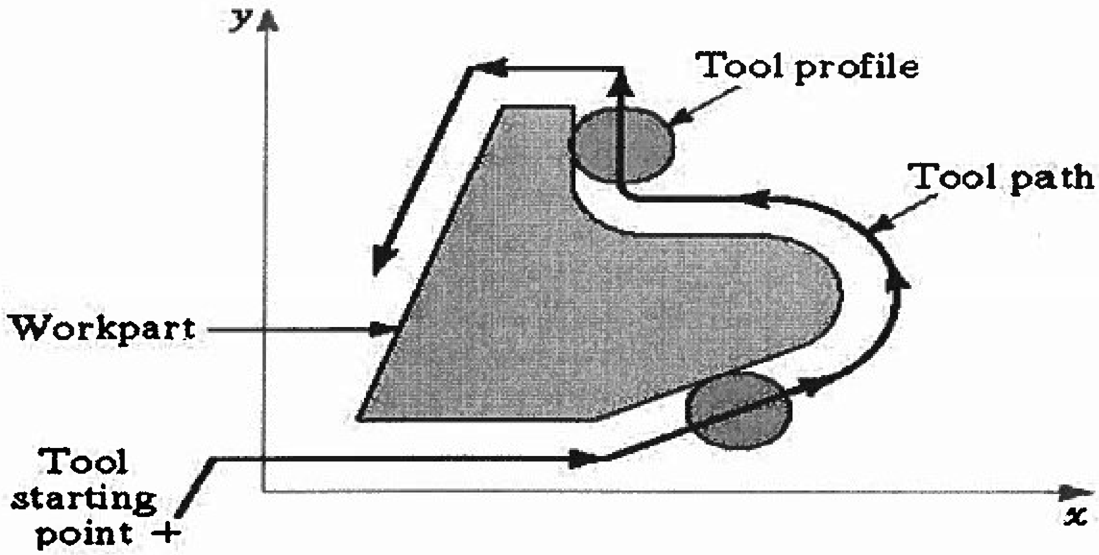
Classification of NC Systems

CNC machine tool systems can be classified in various ways such as:

1. Point-to-point or contouring: depending on whether the machine cuts metal while the workpiece moves relative to the tool
2. Incremental or absolute: depending on the type of coordinate system adopted to parameterise the motion commands
3. Open-loop or closed-loop: depending on the control system adopted for axis motion control

Point-to-point System:

This is used for more complex movements where the arm is controlled in a series of steps that have been stored in memory. The programming is usually performed by the use of teach pendant. Although the movement is normally under servo control, there is no coordinated motion between the axes. Each axis operates at its maximum rate until it reaches the desired endpoint position. The intermediate path, velocity, and relative motion between axes are not controlled. This is adequate for many applications where only the activity at the endpoint positions is important. Applications like spot welding are examples of point to point operations.



In modern machines there is capability for programming machine axes, either as point-to-point or as continuous (that is contouring)

Numerical Control:

Automatically controlling a machine tool based on a set of pre-programmed machining and movement instructions is known as numerical control, or NC.

In a typical NC system, the motion and machining instructions and the related numerical data, together called a part program, used to be written on a punched tape. The part program is arranged in the form of blocks of information, each related to a particular operation in a sequence of operations needed for producing a mechanical component. The punched tape used to be read one block at a time. Each block contained, in a particular syntax, information needed for processing a particular machining instruction such as, the segment length, its cutting speed, feed, etc. These pieces of information were related to the final dimensions of the workpiece (length, width, and radii of circles) and the contour forms (linear, circular, or other) as per the drawing. Based on these dimensions, motion commands were given separately for each axis of motion. Other instructions and related machining parameters, such as cutting speed, feed rate, as well as auxiliary functions related to coolant flow, spindle speed, part clamping, are also provided in part programs depending on manufacturing specifications such as tolerance and surface finish. Punched tapes are mostly obsolete now, being replaced by magnetic disks and optical disks.

Computer Numerically Controlled (CNC):

Computer Numerically Controlled (CNC) machine tools, the modern versions of NC machines have an embedded system involving several microprocessors and related electronics as the Machine Control Unit (MCU). Initially, these were developed in the seventies in the US and Japan. However, they became much more popular in Japan than in system.

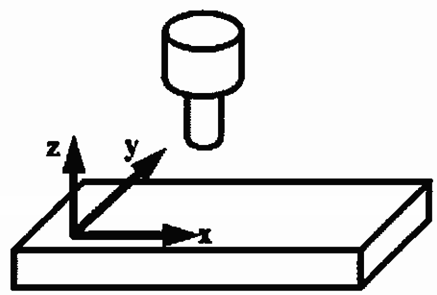


Fig. 23.5 Co-ordinate system for drilling and milling

For a tool with a horizontal spindle the x-axis is across the table, the y-axis is down, and the zaxis is out.

In addition to the translational motion, rotary motions around the axes parallel to X, Y, and Z can also be defined. Similarly, in addition to the primary motion coordinates, secondary coordinates can also exist.

Incremental Systems:

In an incremental system the movements in each Part program block are expressed as the displacements along each coordinate axes with reference to the final position achieved at the end of executing the previous program block.

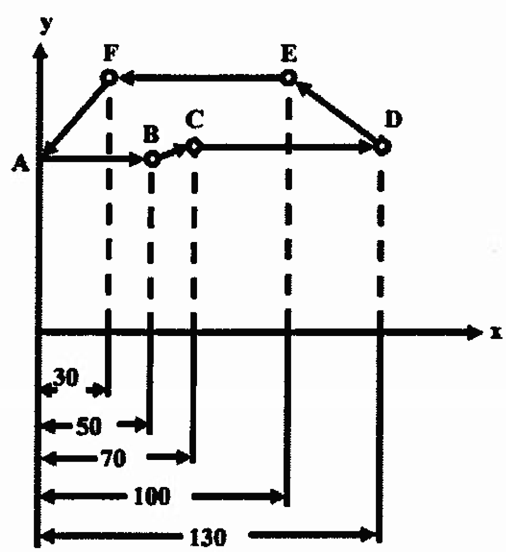
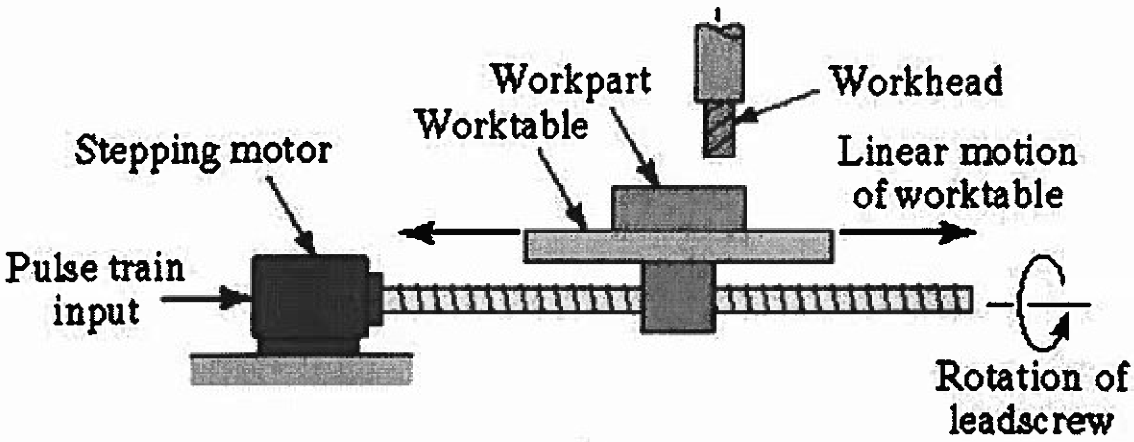


Fig. 23.6 A trajectory for drilling

Consider, for example, the trajectory of rectilinear motions shown in Fig. 23.6 for a PTP system. In an incremental system, the motion parameters, along the X-axis, for the segments, A-B, B-C, C-D, D-E, E-F and F-A, would be given as, 50, 20, 60, -30, -70 and –30, respectively.

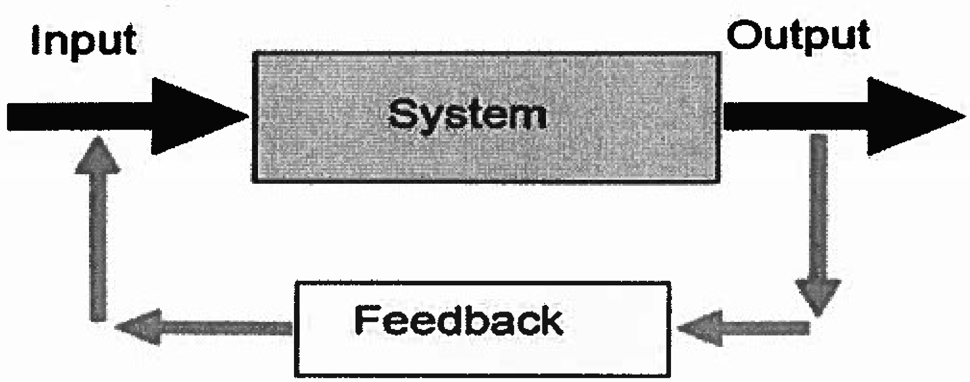


The primary drawback of open-loop system is that there is no feedback system to check whether the commanded position and velocity has been achieved. If the system performance is affected by load, temperature or friction then the actual output could deviate from the desired output.

For these reasons, the open-loop system is generally used in point-to-point systems where the accuracy requirements are not critical. Contouring systems do not use open-loop control.

Closed Loop systems:

Closed-loop control, as described in the module on controllers, continuously senses the actual position and velocity of the axis, using digital sensors such as encoders or analog sensors such resolvers and tachogenerators and compares them with the setpoints. The difference between the actual value of the variable and its setpoint is the error. The control law takes the error as the input and drives the actuator, in this case the servo motor and its drive system, to achieve motion variables that are close to the set points.



Holes

Both drill bits and end milling tools are used by machine operators to machine CNC parts. Use standard drill bits of dimensions measured in metric or imperial units as a guide when deciding on the diameter of the holes in your design. It is technically possible to have any diameter above one millimeter. When holes need to be very tolerant, the engineers use finishing reamers and boring tools. It is recommended for a hole less than about 20 millimeters in standard diameter that require high precision.

Threads

The recommended thread size is M6 or higher for the design of CNC machined parts, but you can only use M2 as a minimum. Machine operators use CNC threading tools for cutting threads down to M6, thus reducing the risk of tap disrupting. Could cut to M2 taps and dies.

Three times the nominal diameter the recommended thread length and a minimum nominal diameter are 1,5 times. You need to add an unthreaded length equal to 1,5 times the nominal diameter at the bottom of the hole for all threads below M6. The hole can be threaded over its whole length for threads larger than M6.

Internal Edges

The recommended vertical corner radius for internal edges is one third or more of the cavity depth. When using the recommended corner radii, a diameter tool is used that complies with the recommended cavity depth guidelines. The slightly higher corner radii than the recommended quantity make it possible to cut along a circular path rather than a 90-degree angle that provides a superior finish for CNC machining parts.

Cavities

The recommended depth of a cavity is four times its width because the cutting length of end mills is limited. Usually, this limit is 3-4 times the tool diameter. Increased vibration, deflection, and chip evacuation are the result of low depth-to-width ratios.

You can use a variable cavity depth to solve this problem if you need greater depths for your particular design. With special tools, you can have a ratio of 30:1 for tool diameter and cavity depth.

Thin Walls

The walls of your CNC machined component should ideally be of a thickness of at least 0,8 mm for metals or 1,5 mm for plastics, although a thickness of 0,5 mm is technically doable, too.

Thinner walls increase the vibrations during the processing process and reduce the degree of precision. Thinner walls of plastic may also warp due to residual stress or adjust due to increasing temperatures.

Machine epsilon helps notate and measure the effect of rounding errors, which can be invaluable for predicting the variance in round or cylindrical parts where π-based calculations are necessary. Learning about mathematical concepts such as machine epsilon is a must for manufacturing complex parts.

Maximum Work Envelope

Trying to work with parts that are at the extreme edge of a machine's capacity can have an adverse effect on CNC machine accuracy. As noted in one Modern Machine Shop article, a machine may be "able to hold tolerances within a specific area of the work envelope, but when the machine is cutting at the outer reaches of this area, features in this vicinity on the large part are not produced to tolerance."

This could be caused by flaws in the "volumetric accuracy" of a machine that are not noticeable when working on small parts but are more obvious when the machine is stretched to the limits of its work envelope.

Discovering the edges of this safe work envelope may require some experimentation with your milling machine, with the manufacture of parts at different positions throughout its manufacturer-approved work envelope to see what, if any, changes there are in part accuracy.

Tool Positioning and Deflection

Another reason that milling machine accuracy may suffer is that the tooling used to shape a part may deflect when it comes into contact with the workpiece. This may happen if the tooling isn't properly secured, or if the apparatus holding the tool is extended too far from its anchor.

For example, operators of boring mill machines often keep the spindle short so it doesn't project too far from the headstock. This increases the stability of the spindle, making it less likely to deflect when the tool comes into contact with the workpiece.

Keeping an eye on how a tool is positioned, and reworking the positioning of a tool, can help you improve milling machine accuracy on future projects as you become more familiar with the limits of a machine before tool deflection becomes an issue.

Machine Accuracy and Maintenance

Maintenance has an enormous impact on CNC machine accuracy. After all, a tool with rusty joints that haven't been maintained cannot complete smooth motions consistently. A lack of lubricant for cutting tools can lead to tooling and parts overheating creating irregularities in a cut. If the grit lines on a waterjet cutting machine are clogged, the grit may not flow properly into the cutting stream, which may leave a cut unfinished.

When investigating the cause of reduced machine accuracy, be sure to conduct a thorough inspection of the machine. In fact, such inspections are also useful when buying used machinery since they help you verify that you're getting a quality machine tool.

Reducing tool wear

Tool regrinding to extend the life of their tools.
Use special cutting oil for sufficient lubrication.
Choose the correct lathe tools for machining.

Reducing the thermal deformation of the process system

The thermal error of the machine tool is dependent on cutting speed, feed, machining time and environmental temperature.
Conclusion: It is known that the workpiece error consists of two parts: machine tool error (including the geometric error and thermal-induced error) and cutting-induced error. After you read this article, you will know how to improve the cnc machining accuracy and efficiency.

CNC Machine Elements

Machine Structures:

- The machine structure is the load carrying and supporting member of the machine tool.
- All motors, drive mechanisms and other functional assemblies of the machine tools are aligned to each other and rigidly fixed to the machine structure.
- The machine structure is subjected to static and dynamic forces and it should not deform or vibrate beyond the permissible limits under the action of these forces.
- All components of the machine must remain in correct relative positions to maintain the geometric accuracy, regardless of the magnitude and direction of these forces.
- The machine structure configuration is also influenced by the considerations of manufacture, assembly and operation [4].

tool or a workpiece is held.
    - To absorb all the static and dynamic forces.
- The shape and size of the work produced depends on the accuracy of the movement and on the geometric and kinematic accuracy of the guideway.
- The geometric relationship of the slide (moving part) and the guideway (stationary part) to the machine base determines the geometric accuracy of the machine.
- Kinematic accuracy depends up on the straightness, flatness and parallelism errors in guideways.
- Factors considered while designing guideways;
    - Rigidity
    - Damping capability
    - Geometric and kinematic accuracy
    - Velocity of slide
    - Friction characteristics
    - Wear resistance
    - Provision for adjustment of play
    - Position in relation to work area
    - Protection against swarf and damage.

Guideways are primarily of two types; o Friction guideways o Antifriction linear motion (LM) guideways

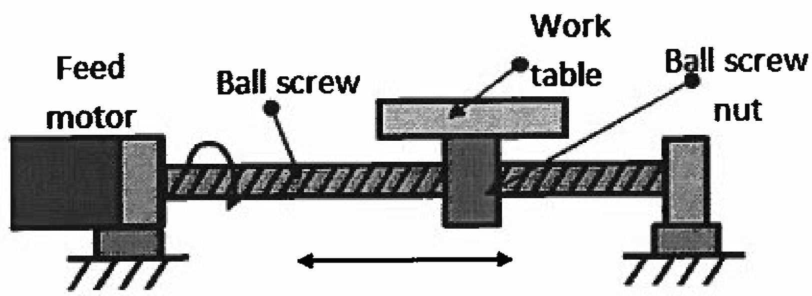


Fig. 4.1.2 Typical feed drive

- The feed motor must run smoothly.
- The drive should have extremely small positioning resolution.
- Other requirements include high torque to weight ratio, low rotor inertia and quick response in case of contouring operation where several feed drives have to work simultaneously.

Variable speed DC drives are used as feed drives in CNC machine tools. However now-a-days AC feed drives are being used.

Spindles:

The spindle drives are used to provide angular motion to the workpiece or a cutting tool. Figure 4.1.1 shows the components of a spindle drive. These drives are essentially required to maintain the speed accurately within a power band which will enable machining of a variety of materials with variations in material hardness. The speed ranges can be from 10 to 20,000 rpm. The machine tools mostly employ DC spindle drives. But as of late, the AC drives are preferred to DC drives due to the advent of microprocessor based AC frequency inverter. High overload capacity is also needed for unintended overloads on the spindle due to an inappropriate feed. It is desirous to have a compact drive with highly smooth operation.

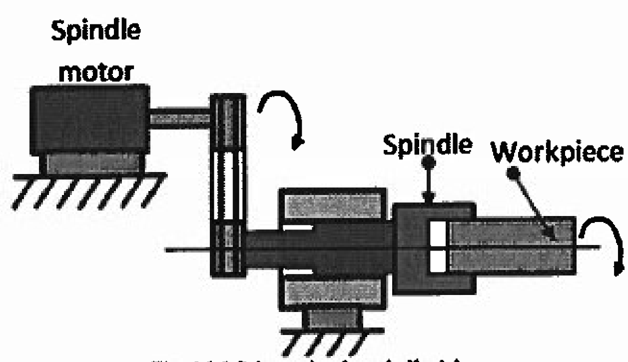
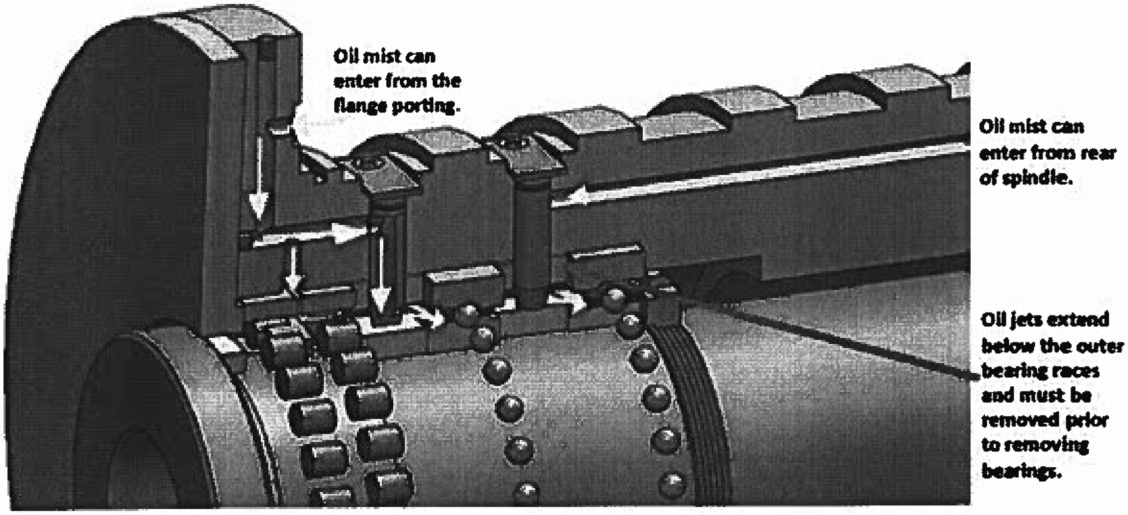


Fig. 4.1.1 Schematic of a spindle drive

Spindle Bearings:

There are four separate categories for bearings used in machine tool spindles. Each bearing design has characteristics that make it useful for certain applications, and it's

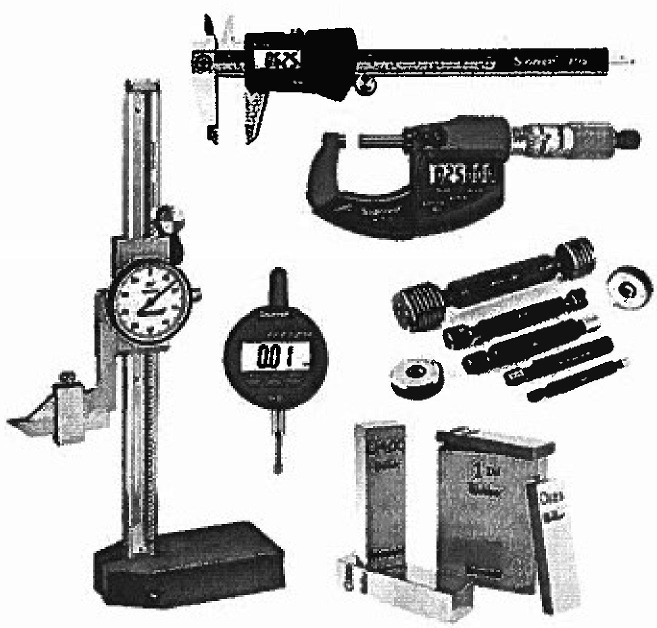


Measuring Systems:

To make sure each CNC machining part is manufactured with the right specification, the size and tolerance should be measured with specific sophisticated CNC metrology tools [6].

1. ***Coordinate Measuring Machine (CMM)***

The CMM establishes a mechanical coordinate system with the platform of measuring machine as the reference plane, to collect the coordinate values of the measured points on the surface of the measured workpiece, then project it into the spatial coordinate system to construct a spatial model of the workpiece. It's designed to measure various aspects automatically, applicable from small hardware parts to the whole machine.



6. Calipers

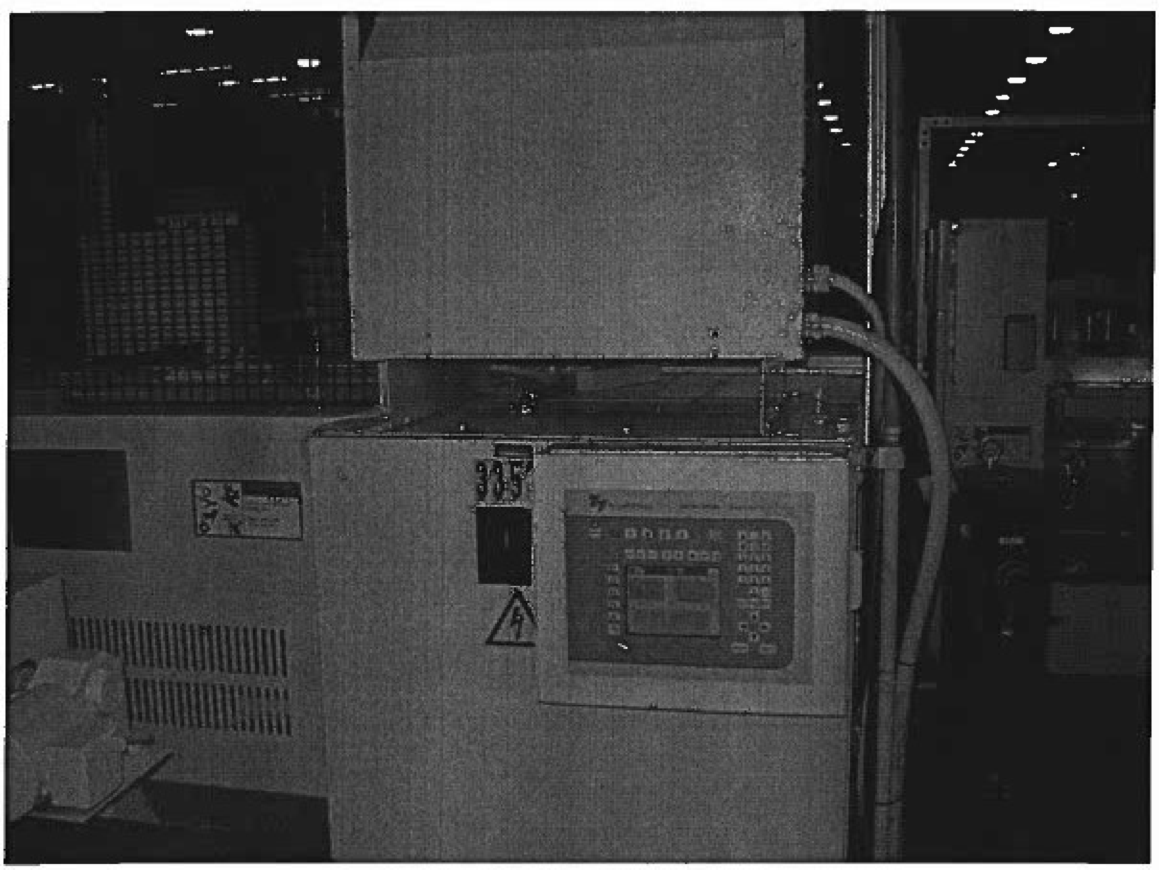
Calipers are a kind of metrological device used to measure the distance between two opposite sides of a part, there is a wide range of calipers of different sizes and shapes.

7. Air Gage

The principle of the Air Gage is to eject air from a calibrated nozzle, and then record the rate at which the air returns to multiple sensor nozzles. The size of the object is measured by reading the air flow between the measured object and the measuring tool.

Tool Mentoring Systems:

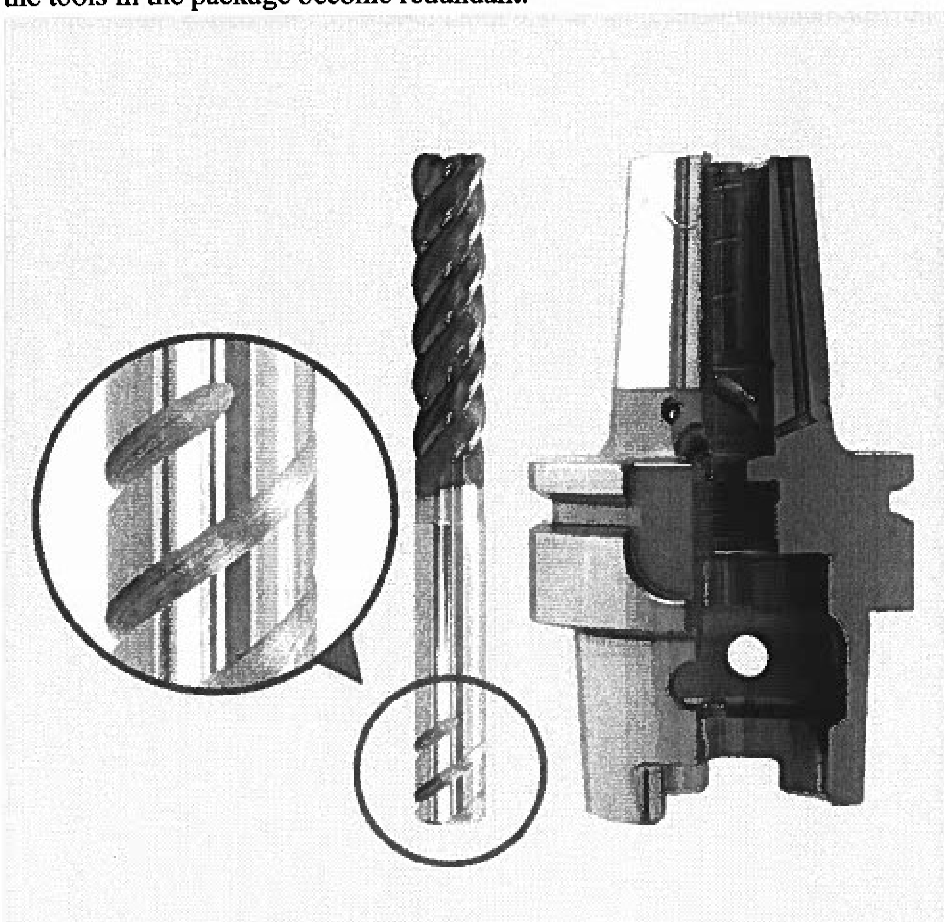
Computer Numeric Control (CNC) machines are the important tool management and positioning machines used in various manufacturing centers. These machines use computer systems to control the machine tools (lathes, mills, and grinders). With such dependability on CNC machines, it is very important that the CNC machines should be periodically assessed and ensure they are in good working condition. Today, diverse machine tool monitoring systems are used for the purpose of monitoring CNC machines. These systems gather information from CNC machine components or parts and process them to interpret their working conditions and capabilities [7].

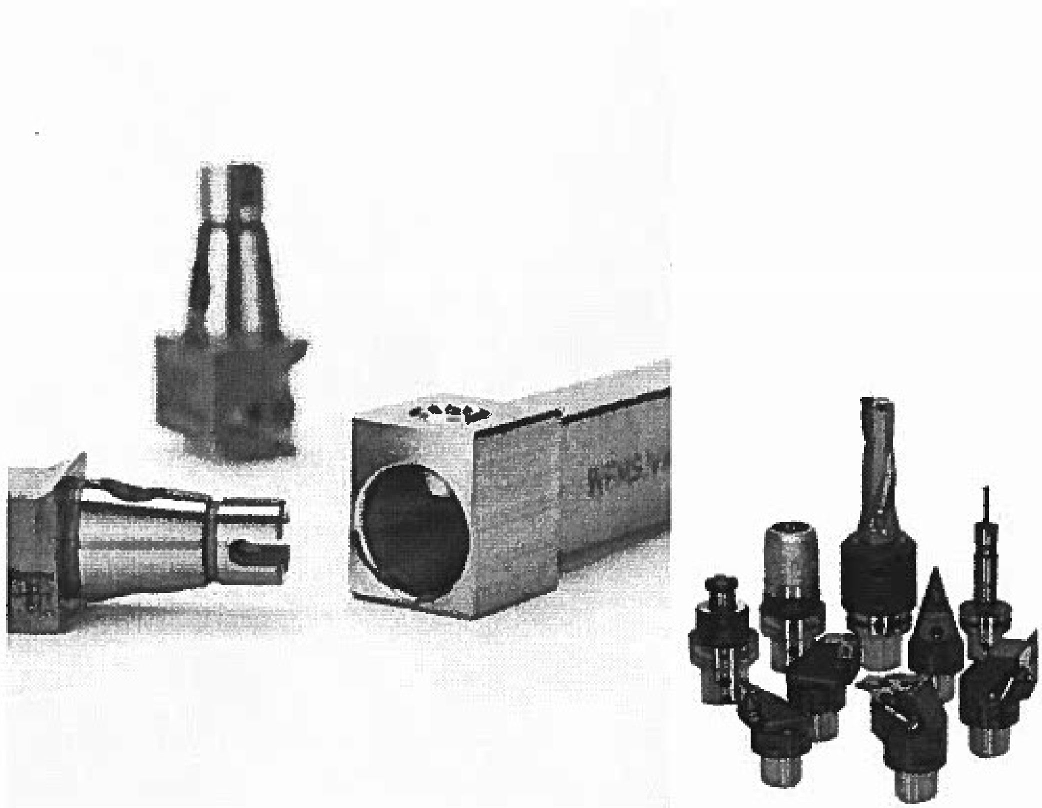


UNIT - II

Tooling for CNC Machines

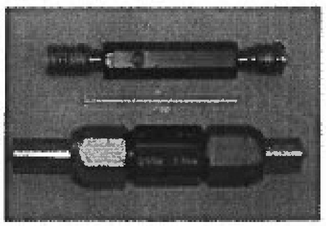
Prior to the purchase of a new machine tool, or indeed for a reappraisal of the tooling requirements for an established machine within the plant, the cutting tools should also be assessed and thereby available when the machine is ready to work. Typically, a good tooling package will cost no more that 5% of the cost of, say, a turning centre, but is usually considerably more expensive when milling applications are required. These tooling costs will obviously depend on the manufacturer's requirements and as an example of this, if a large manufacturer's production needs are only for a single part, or family of parts, then it is unlikely that a wide range of tooling is necessary. Conversely, when perhaps a jobbing shop specifies its tooling requirements, then it is normal to suppose that a diverse range of parts will be manufactured, needing a wider range of tools. Often tooling manufacturers will sell tooling packages for specific machine tools, but as they are meant for universal usage they are rarely exactly right for a given application. This means that the manufacturer of parts will have to supplement the tooling inventory to make the parts they need, and as a result some of the tools in the package become redundant.

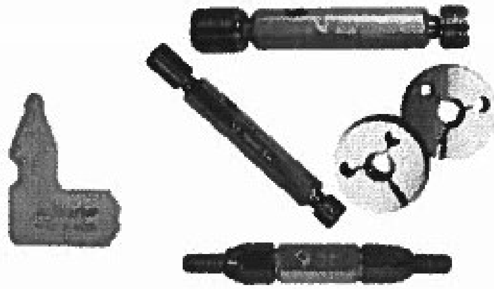




Preset tooling saves time during setup, as well as when tools are changed during the job's run, by reducing or eliminating test cuts, measurements, and adjustments. On screw machines in particular, where the "brass hammer method" is often used, these adjustments require either substantial skill or substantial time. The amount of time saved through the use of this tooling has to be balanced against the time required for presetting. However, even if there is no apparent reduction in labor hours, there will be an increase in the number of hours available for production on the machine. This is because presetting is part of "external" setup or operating time. That is, it can be done while the machine continues to make pieces. Whether the benefits of this type of tooling come in the form of reduced labor or increased uptime, they may be most significant on newer, more expensive, advanced technology machines which carry a higher machine hour rate.

In this report, preset tooling has been handled separately from "quick-change," which has been handled separately from "adjustable," etc. The purpose of this is to be clear about exactly which benefits are inherent in each type of tooling. However, in actual practice these types are commonly combined, with examples such as "preset, quick-change tooling," or "quick-change, adjustable tooling" coming to mind. There is a question regarding the feasibility of this tooling on some cam machines, since the end points of tool slides are not necessarily predictable on a given job, or repeatable from one run to the next. In some cases, this is due to small differences between "identical" cams which are used interchangeably. In addition, on single spindle machines the high and low points on the lead cam may not be exact, although some presetting systems can correct for this. These problems can be overcome by purchasing new cams to closer tolerances; but for the shop with a large near to the desired dimension. One of the most common types is the carbide insert/insert tool holder combination. Installed in the machine, any combination of "identical" inserts and tool holders will generally be located within ?.005" of their nominal dimension. Like the pre-gaged type above, this tooling is not adjustable; and there must be a way on the machine to compensate for these small variations, following a trial cut and measurement.





Coolant Fed Tooling System:

From twist drills to end mills, cobalt to carbide, CNC toolholders and high-pressure pumps. CFT Systems™ has led the industry for decades in advancing the state-of-the-art in coolant-fed tooling systems. Today, our global customer base relies on CFT Systems™ to increase both productivity and bottom line profitability in some of the world's most demanding machining applications. We invite you to review the many coolant-fed products, product groups and technologies we have pioneered to help sharpen your competitive edge.

Increased tool life
By directing coolant to the cutting edge of the tool, lubrication is improved and friction is significantly reduced to substantially increase tool life.

Increased Speeds & Feeds
The flushing action of the coolant forces chips away from the workpiece, eliminating compaction, clogging and chip re-cutting, to achieve maximum speed and feed rates.

Improved Accuracy
The free cutting action of coolant-fed tools, combined with more effective chip ejection, provides improved cutting performance and enhanced accuracy.

Reduced Secondary Operations
The reduction of heat, friction and galling reduces the potential for stress cracking, while improving surface integrity. The improved finish may eliminate the need for costly secondary operations like reaming, boring and grinding.

competitive with crude machine-table setups. Here, modular fixtures increase quality and accuracy, yet still maintain competitive costs.

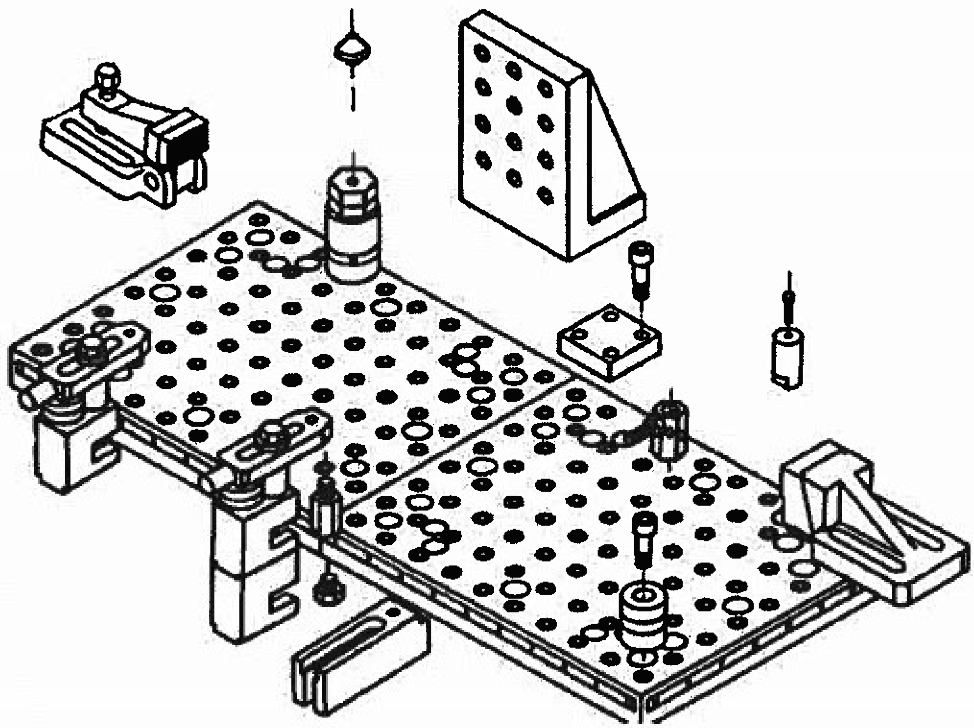


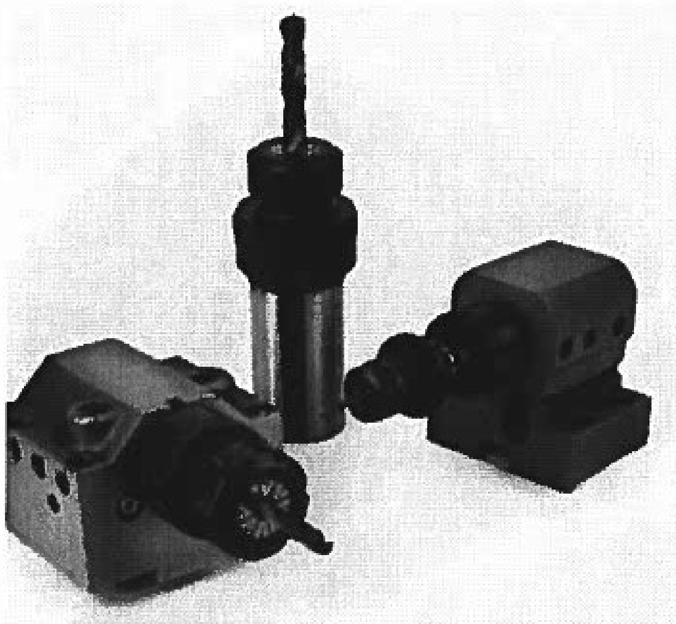
Fig. Modular workholders can be assembled entirely from standard off-the-shelf components.

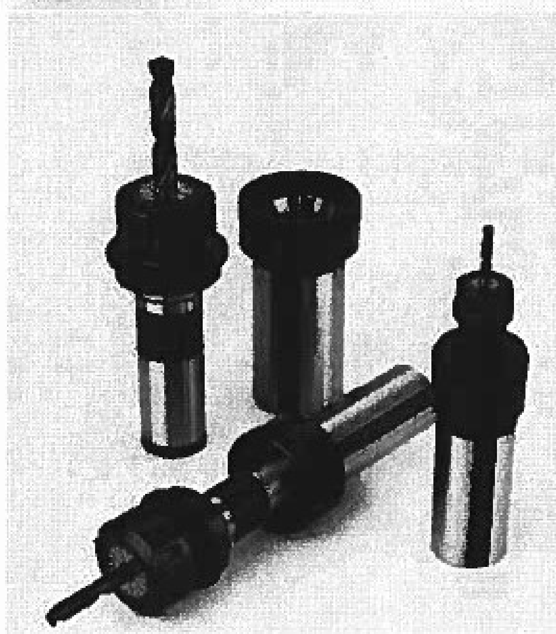
Infrequent Production Runs. Jobs that do not repeat on a regular basis are well suited to modular fixturing. Today shorter lead times are quite common. Modular fixturing permits rapid setup of short-notice production runs. Once again, modular workholders offer many of the benefits of special-purpose tooling at a fraction of the cost.

Prototype Parts. Prototype or experimental parts frequently require special workholders. Since prototype workpieces are often changed or redesigned, the cost of building jigs or fixtures for each new variation is prohibitive. Modular fixturing is the best alternative. With modular workholders, each variation of the workpiece can be quickly fixtured with little or no downtime.

Replacement Parts That Are Made to Order. Replacement parts are an expensive problem in many companies. In the past, these parts were made in large lots and placed in storage. Some parts were quickly sold while others were never ordered. Modular fixturing eliminates the need for an inventory of slow-moving replacement parts. Modular fixturing permits a company to respond to orders as they are received. Instead of shipping parts from an inventory, parts can be made as needed.

Trial Fixturing Techniques. Trial fixturing is common throughout manufacturing organizations. Before any product goes into production, workholders must be designed, built, and tested. Assembling a modular workholder for workpiece allows the tool designer to test





Heimatec makes the HT Quick Change tooling system for use with its line of live tools and angle heads, allowing them to remain permanently mounted in the machine. A removable insert holding the cutting tool easily locks into the live tool. Inserts are available for various components, such as ER collets, side lock holders and facemill adapters.

"To change the tool, a single clamping taper screw is loosened up on the live tool cylinder guide; the insert comes out and you put a different one in," said Hansen, who added that for a minimal cost, a machinist can have another insert sitting on the side ready to go. "When a part's being changed, they just put in the new insert. The changeover is very quick versus taking the live tool out of the machine and having to reset everything."

2. Computer assisted part programming
3. Manual data input 4. NC programming using CAD/CAM
5. Computer automated part programming

In manual part programming, the processing instructions are documented on a form called a part program manuscript. The manuscript is a listing of the positions of the tool relative to the work piece that the machine must follow in order to perform the processing. The listing may also include other commands such as speeds, feeds, tooling, and so on. A punched tape is then prepared directly from the manuscript. In computer-assisted part programming, much of the tedious computational work required in manual programming is performed by the computer. For complex work part geometries or jobs with many processing steps, use of the computer results in significant savings in the part programmer's time. When computer assisted part programming is used, the programmer prepares the set of processing instructions in a high-level computer language. For complex jobs, this computer language is much easier to use than the lower-level coding required in manual part programming. The high-level language commands are interpreted by the computer, and the required calculations and data processing are accomplished to prepare the NC program for the tape reader (or other input device). Manual data input (MDI) is a procedure in which the NC program is entered directly into the MCU at the site of the processing machine. Consequently, the use of the punched tape is avoided, and the programming procedure is simplified to permit machine operators rather than part programmers to do the programming.

NC part programming using CAD/CAM is an advanced form of computer-assisted part programming in which an interactive graphics system equipped with NC programming software is used to facilitate the part programming task. The term CAD/CAM means computer-aided design and computer-aided manufacturing. In this method the programmer works on a CAD/CAM workstation to enter the machining commands. The actions indicated by the commands are displayed on the graphics monitor, which provides visual feedback to the programmer. Also, certain portions of the programming cycle are automated by the NC programming software to reduce the total programming time required.

Computer-automated part programming extends the notion of automating certain portions of the. NC part programming procedure to its logical conclusion. It automates the complete part programming task using software that is capable of making logical and even quasi intelligent decisions about how the part should be machined.

Manual Part Programming:

In manual programming, the part programmer specifies the machining instructions on a form called a manuscript. Manuscripts come in various forms, depending on the machine tool and tape format to be used. For example, the manuscript form for a two-axis point-to-point drilling machine would be different than one for a three-axis contouring machine. As mentioned, the manuscript is a listing of the relative tool and workpiece locations. It also includes other data, such as preparatory commands, miscellaneous instructions, and speed/feed specifications, all of which are needed to operate the machine under tape control.

(EIA). While the official language was documented as RS-274D, you'll hear everyone refer to it as G-code. Why? Many of the words, or individual pieces of code, that make up this machine-based language start with the letter G.

M codes are machine codes that might differ between CNC machines. These codes control functions on your CNC machine like coolant and spindle directions.

A line of g-code is commonly called a "Block".

The sequence of a G-code block is shown below:

G01 X1 Y1 F20 T01 M03 S500

Multiple line of G-code combine together to form a complete CNC program.

Basic Concept Of Manual Part Programming:

This technique is widely used for workpieces of relatively simple geometry. The steps in manual programming are [8]:

i. Careful study of component drawing- materials, tolerances, surface finish etc.
ii. Select the raw material or blank if not specified.
iii. Select the number of set ups necessary and the machine/s on which the part is machined.
iv. Deciding the workpiece datum for each set up.
v. Designing the fixtures or holding of the job.
vi. Deciding the process and sequence of processes to achieve the desired accuracy and tolerances
vii. Selecting the tools and cutting parameters.
viii. Writing the program
ix. Input the program and dry run; correct mistakes if any.
x. Produce the first part and inspect.
xi. Correct the program if necessary and progress to lot production.
xii. Create documentation for future reference.
xiii. Archive the program and documentation.

It was mentioned earlier that an NC program will consist of a number of lines called blocks. Each block will consist of a number of words. Each word will have two components: a word address and a numeric code representing information. The common word addresses are:

N - G - X - Y - Z - A - B - C - F - S - T – M

where

N = sequence number of instructions

G = preparatory function

XYZABC = co-ordinate and angular data

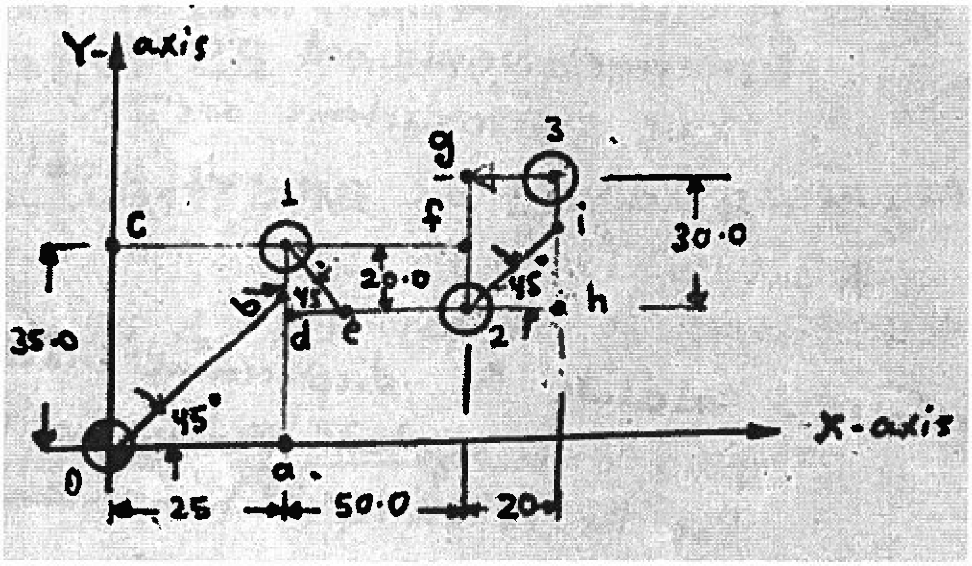
F = feed

S = spindle speed

T = tool code

M = miscellaneous function

Positioning systems are the simplest machine tool control systems and are therefore the least expensive of the three types. However, for certain processes, such as drilling operations, tapping, riveting and spot welding, PTP is perfectly suited to the task and any higher level of control would be unnecessary. Example bellow illustrate path of three drilled holes.



Path of three drilled holes				
Programmed	Tool path		Motion	
	Sequential	Simultaneous	from	to
x25.0 y35.0	0-a-1	0-b-1	0	1
x50.0 y-20.0	1-d-2	1-e-2	1	2
x20.0 y30.0	2-h-3	2-i-3	2	3

Sequential: - the system will move in one axis at a time.
Simultaneous: - both axes start at the same time, the tool path will be approximately.

Canned Cycles:

A canned cycle is a combination of machine movements that perform machining operations like drilling, milling, boring and tapping. For example, a drilling cycle consists of the following movements of the tool:

- Fast approach to workpiece
- Drill at feed rate
- Rapid return to initial position or to rapid level.

Ordinarily 3 blocks are required to program this drilling operation. Use of a canned cycle reduces this to one block. Once a canned cycle has been called, the system will execute the canned cycle at every subsequent table positioning. Therefore it is very important to call off (cancel) the canned cycle. The code G80 cancels all canned cycles. Canned cycle for drilling is G81.This cycle (G81) is shown in Fig. 12.29. Figure 12.30 also shows a few other typical canned cycles used in machining centres.

In CNC lathes several multiple, repetitive turning cycles like longitudinal turning

of numerical values and that can be used as particular functions.
Functions used in parametric programming:

- Program L variables,
- External E parameters.

"L" Local variables

Definition

Variables are elements that can be substituted for numerical values to provide a programming aid. Program variables are defined by letter address L followed by a number from one to three digits.

L variables represent decimal numbers are should be used in order to keep the maximum precision on floating point operation (divide, square root, trigonometric etc.)

List of L Variables

- Variables L0 to L19,
- Variables L100 to L199,
- Variables L900 to L959.

Variables L0 to L19, L100 to L199, L900 to L959 have the same format and use but cause differences in programming (see chapter 7.2).

Variable Assignments

L Variables can be assigned to all the programmable NC addresses.

The assignment of an L variable to an NC address automatically results in the correct use of the unit for the programmed address.

Initialisation

The variables are initialised to zero:

- at power on,
- at the end of the program (M02),
- after a reset.

Application

The values assigned to L variables can be:

- integer or decimal numbers (maximum 8 digits plus sign),
- fixed values or values resulting from operations.

Use

L Variables can be used:

- to perform operations,
- for increments and decrements,
- for conditional branches with function G79 after comparison with an expression, use caution with equivalence tests.
- jointly with programming of external E parameters to make transfers.

first part of the book, we focus on computers as a foundation for computer-aided design and manufacturing.

The modern digital computer is an electronic machine that can perform mathematical and logical calculations and data processing functions in accordance with a predetermined program of instructions. The computer itself is referred to as hardware, whereas the various programs are referred to as software. There are three basic hardware components of a general-purpose digital computer:

i. Central processing unit (CPU)
ii. Memory
iii. Input/output (I/O) section

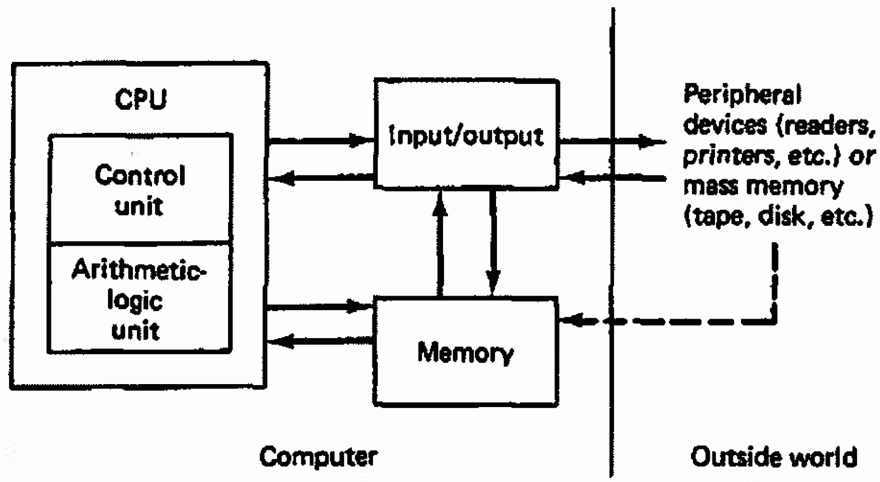


FIGURE 2.1 Basic hardware structure of a digital computer.

The relationship of these three components is illustrated in Figure 2.1. The central processing unit is often considered to consist of two subsections: a control unit and an arithmetic-logic unit (ALU). The control unit coordinates the operations of all the other components. It controls the input and output of information between the computer and the outside world through the I/O section, synchronizes the transfer of signals between the various sections of the computer, and commands the other sections in the performance of their functions. The arithmetic-logic unit carries out the arithmetic and logic manipulations of data. It adds, subtracts, multiplies, divides, and compares numbers according to programmed instructions.

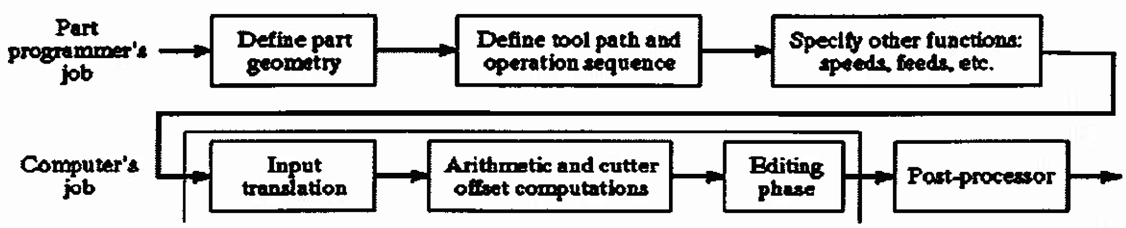
The memory of the computer is the storage unit. The data stored in this section are arranged in the form of words which can be conveniently transferred to the ALU or I/O section for processing. Finally, the input/output provides the means for the computer to communicate with the external world. This communication is accomplished through peripheral equipment such as readers, printers, and process interface devices. The computer may also be connected to external storage units (e.g., tapes, disks, etc.) through the I/O section of the computer. Figure 2.2 shows a modern large computer with associated peripheral equipment including storage units, card reader, and printer.

controller.

- When using one of the part programming languages, the two main tasks of the programmer are:
  (1) Defining the geometry of the workpart.
  (2) Specifying the tool path and operation sequence.
- To program in APT, the part geometry must first be defined. Then the tool is directed to various point locations and along surfaces of the workpart to accomplish the required machining operations.
- The viewpoint of the programmer is that the workpiece remains stationary, and the tool is instructed to move relative to the part.
- To complete the program, speeds and feeds must be specified, tools must be called, tolerances must be given for circular interpolation, and so forth.

There are four basic types of statements in the APT language:

1. **Geometry statements**, also called definition statements, are used to define the geometry elements that comprise the part.
2. **Motion commands** are used to specify the tool path.
3. **Postprocessor statements** control the machine tool operation, for example, to specify speeds and feeds, set tolerance values for circular interpolation, and actuate other capabilities of the machine tool.
4. **Auxiliary statements**, a group of miscellaneous statements used to name the part program, insert comments in the program and accomplish similar functions.



1- Define the part geometry

- Underlying assumption: no matter how complex the part geometry, it is composed of basic geometric elements and mathematically defined surfaces
- Geometry elements are sometimes defined only for use in specifying tool path
- Examples of part geometry definitions:
  P4 = POINT/35, 90,0
  L1 = LINE/P1, P2
  C1 = CIRCLE/CENTER, P8, RADIUS, 30.0

2- Specify the tool path and Operation Sequence

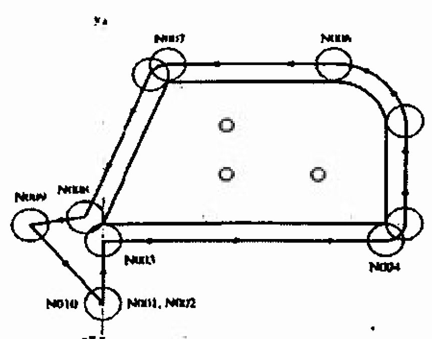
- Tool path consists of a sequence of points or connected line and arc segments, using previously defined geometry elements
- Point-to-Point command:
  GOTO/P0

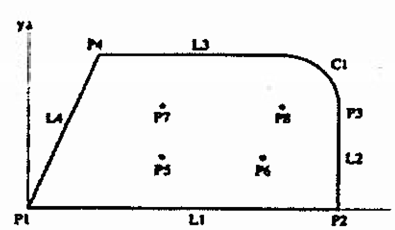
FEEDRAT/0.05, IPR
GODLTA/0, 0, -25.0
GODLTA/0, 0, 25.0
RAPID
GOTO/P6
SPINDL/1000, CLW
FEEDRAT/0.05, IPR
GODLTA/0, 0, -25.0
GODLTA/0, 0, 25.0
RAPID
GOTO/P7
SPINDL/1000, CLW
FEEDRAT/0.05, IPR
GODLTA/0, 0, -25.0
GODLTA/0, 0, 25.0
RAPID
GOTO/PTARG
SPINDL/OFF
FINI

Example:

Cutter diameter data has been manually entered into offset register 05. At the beginning of the job, the cutter will be positioned so that its center tip is at a target point located at $x = 0$, $y = -50$, and $z = +10$. The program begins with the tool positioned at this location.

Feed = 50 mm/min., Speed = 1000 rev/min.,
Cutter diam. = 20 mm.





PARTNO SAMPLE PART MILLING OPERATION
MACHIN/MILLING,02
CLPRNT
UNITS/MM
CUTTER/20.0
REMARK Part geometry, Points and Lines are defined 25 mm below part top surface.
PTARG = POINT/0, -50.0, 10.0
P1 = POINT/0, 0, -25.0
P2 = POINT/160.0, 0, -25.0
P3 = POINT/160.0, 60.0, -25.0
P4 = POINT/35.0, 90.0, -25.0
P8 = POINT/130.0, 60.0, -25.0
L1 = LINE/P1, P2
L2 = LINE/P2, P3

designer and stored in the CAD/CAM data base. That model contains all of the geometric, dimensional, and material specificatluns for the part.

When the same CAD/CAM system, or a CAM system that has access to the same CAD data base in which the part model resides, is used to perform NC part programming, it makes little sense to recreate the geometry of the part during the programming procedure. Instead, the programmer has the capability to retrieve the part geometry model from storage and to use that model to construct the appropriate cutter path. The significant advantage of using CAD/CAM in this way is that it eliminates one of the tirneconsurning steps in computer assisted part programming: geometry definition. After the part geometry has been retrieved, the usual procedure is to label the geometric elements that will be used during part programming. These labels are the variable names (symbols) given to the lines, circles and surfaces that comprise the part. Most systems have the capacity to automatically label the geometry elements of the part and to display the labels on the monitor. The programmer can then refer to those labelled elements during tool path construction.

This can most readily be done for certain NC processes that involve well defined, relatively simple part geometries. Examples are point to point operations such as NC drilling and electronic component assembly machines. In these processes, the program consists basically of a series of locations in an *x-y* coordinate system where work is to be performed [e.g .. holes arc to be drilled or components are to be inserted). These locations are determined by data that are generated during product design. Special algorithms can be developed to process the design data and generate the NC program for the particular system. *"fe* contounag systems will eventually be capable at a similar level of automation. Automatic programming of this type is closely related to computer-automated process planning (CAPP), discussed in later pages.

The design and implementation of post processors

A CNC post processor is software that converts toolpaths created in a CAM system into NC programs that can be read by a machine's controller to move the cutting tool along the programmed paths in a safe, consistent and predictable manner. Most CAM systems are designed to be machine independent allowing users to program their parts regardless of what machine they will be made on. Toolpath data from the CAM system is stored in machine independent files. These files contain all of the information required to move the cutting tools along the programmed toolpaths and make your part, but how does the motion of the cutting tool translate to machine motion?

This is where the post processor enters the equation. The main role of a post processor is to read toolpath data from machine independent files and convert it into an NC program which can be read by your machine's controller. However, simply converting the data into an NC program formatted for your machine's controller is often not enough.

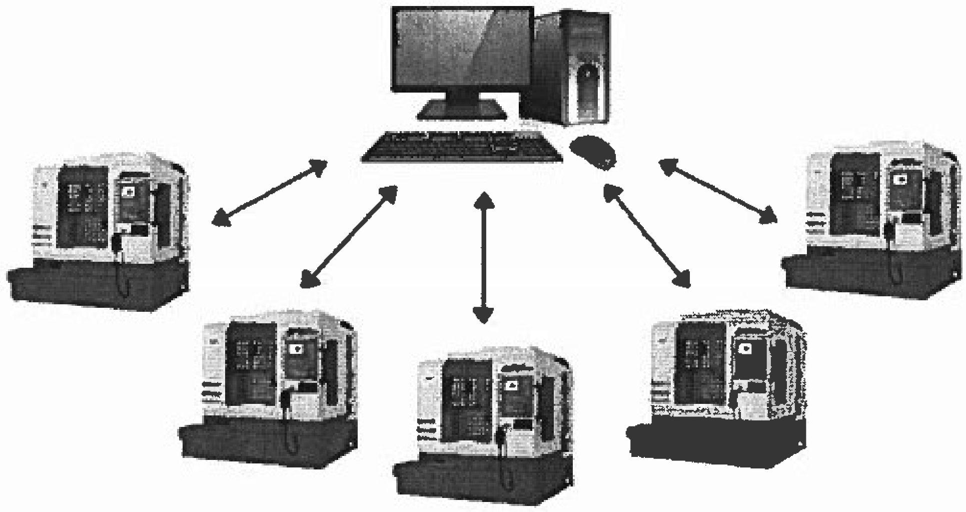
A post processor must also consider your machine's kinematics. The term kinematics refers to the how the axes on your machine move, particularly the rotary axes on a 5-axis machine. The rotary axes on a machine may be attached to the table, the spindle or a combination of both. The configuration of the rotary axes has a great effect on how the data from the CAM system should be post processed. It can affect length compensation, feed rate for exact representation of the body of the product. At the same time solid modeling was recognized as the only system, which could provide an unambiguous representation of the product, but it was lacking adequate support for complex part representations. Today we are experiencing a merge of solid and surface modeling technology. Most solid modeling systems are capable of modeling most of industrial products. Systems sold today (especially for mechanical applications, which are the majority of systems sold world-wide) are characterized as NURBS (Non Uniform Rational B-Spline) based systems, employing solid modeling technology, and they are parametric and feature based systems. The use of CAD systems has also been expanded to all industrial sectors, such AEC, Electronics, Textiles, Packaging, Clothing, Leather and Shoe, etc. Today, numerous CAD systems are offered by several vendors, in various countries.

Tool path generation using CAD/CAM:

The second task of the NC programmer in computer assisted part programming is tool path Specification. The first step in specifying the tool path is to select the cutting tool for the operation. Most CAD/CAM systems have tool libraries that can be called by the programmer to identify what tools are available in the tool crib. The programmer must decide which of the available tools is most appropriate for the operation under consideration and specify it for the tool path. This permits the tool diameter and other dimensions to be entered automatically for tool offset calculations. If the desired cutting tool is not available in the library, an appropriate tool can be specified by the programmer. It then becomes part of the library for future use. The next step is tool path definition. There are differences in capabilities of the various CAD/CAM systems, which result in different approaches for generating the tool path. The most basic approach involves the use of the interactive graphics system to enter the motion Commands one by one, similar to computer assisted part programming. Individual statements in APT or other part programming language are entered and the CAD/CAM system provides an immediate graphic display of the action resulting from the command, thereby validating the statement. A more advanced approach for generating tool path commands is to use one of the automatic software modules available on the CAD/CAM system. These modules have been developed to accomplish a number of common machining cycles for milling, drilling and turning. They are subroutines in the NC programming package that can be called and the Required parameters given to execute the machining cycle.

Computer Automated part programming:

In the CAD/CAM approach to NC part programming, several aspects of the procedure are automated. In the future, it should be possible to automate the complete NC part programming procedure. The proposed system is an automated system where the input is a geometric model of a part that has been defined during product design and the output is a NC part program. The system possesses sufficient logic and decision making capability to accomplish NC part programming for the entire part without human assistance. This can most readily be done for certain NC processes that involve well defined, relatively medium complex part geometries. Special algorithms have been developed to process the design data and generate the NC program.



Direct Numerical Control

The basic DNC system needs following the basic components are the mainframe computers, memory, communication networks, NC machine tools.

The communication network can be arranged either through connecting the remotely located computer, with long cables to the individual machine control directly or connecting the mainframe computer with a small computer at individual operator's station called as satellite computer.

DNC systems are costly and preferably used in large organizations. The combination of DNC/CNC makes possible to eliminate the use of the programme as the input media for CNC machines.

DNC downloads computer programs directly into CNC computer memory. This decreases the amount of communication required between the central computer and each machine tool.

Functions of DNC System

Following are the functions of the DNC machine:

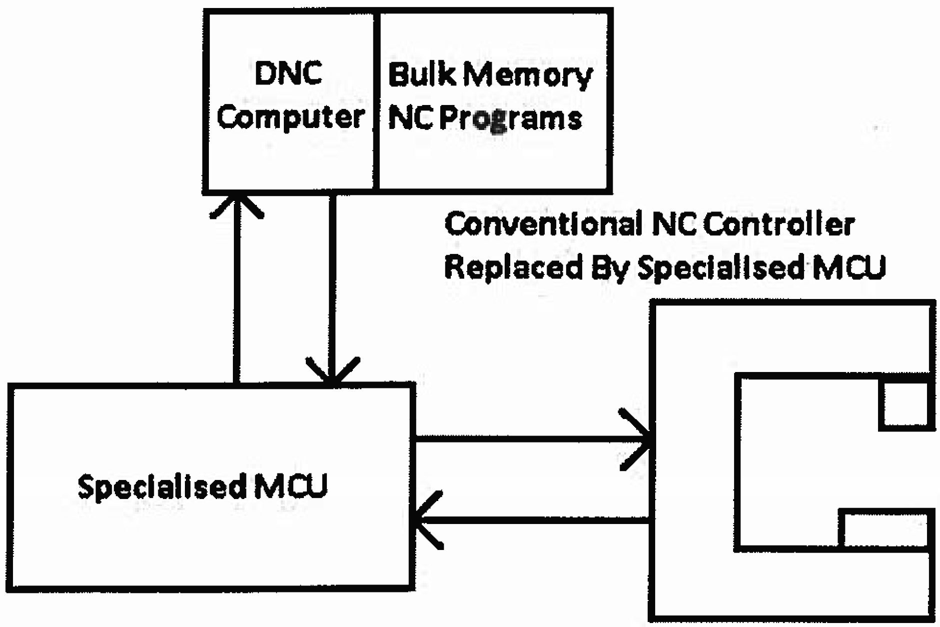
1. For use the central computer for storage and editing programs for all machine tools connected to it.
2. To give the stored programs to the connected machines on demand.
3. For to post-process part programs written in higher-level languages like APT.
4. To combine CAD with CAM by having a common database.
5. To provide a link between a central computer and various plant computers connected through modems and networks even though the plants may be placed several kilometres away from each other.

Components Used in DNC Machine

Following are the main components used in CNC machine:

2. Specialised MCU

In specialised MCU system, replace the normal controller unit with the special machine control unit. The special control unit is created to help communication between machine tools and computers. The specialised MCU configuration achieves a better balance between the accuracy of interpolation and the faster removal rate of the metal than is usually possible with the BTR system.



Specialised MCU

Advantages and Disadvantages of DNC:

Following are the advantages of the DNC system:

1. The DNC rejects the use of tape readers, which are absolutely the weakest component of the NC system.
2. Time-sharing by central control makes it possible to keep close control over the entire machine shop.
3. The huge memory of DNC allows it to store a large number of part programs for subsequent use. It also receives the memories of NC control unit.
4. Presence of a central bulk memory allows the same program to be run on different machines at the same time without duplicating it at individual places.

When the cutting force and torque are too high, the cutter may break in bending or in twist. On the other hand, for maximum productivity, the maximum allowable feeds and cutting speed must be used.

The principle of ACC system is to sense the constraint variable and to adjust the cutting speed and feed according to this measurement and a programmed strategy. In a case where two constraints are used simultaneously, the system must consider the variable which to its maximum permissible value.

The advantage of this ACC system is that the cutting tool is protected against catastrophic failure simultaneously with keeping highest possible feed rate.

Adaptive Control of Machining Processes like turning, grinding.

If you're in the machine tool business, you know that early iterations of CNC adaptive control leave something to be desired. Most are put into a standalone PLC connected to a machine with intricate wiring that complicates setup and slows response. The controller's analog-velocity output typically goes to a separate drive, which in turn controls a velocity loop to the machine — so interjecting adaptive control in these loops degrades already taxed response time. In addition, feedback loops are not always fully closed — and some early adaptive controls did not require or allow tuning.

In contrast, new-generation CNC-based adaptive controls leverage the speed and performance of drive-andcontrol combinations by using controls, spindle motor, servomotors, and amplifiers to directly monitor load on the spindle — and optimize cutting feedrates based on these measurements.

Case in point: Adaptive control called iAdaptS from FANUC FA America, Hoffman Estates, Ill., improves material removal and minimizes cycle time by automatically optimizing cutting feedrate based on actual spindle load. iAdaptS compensates for variations in material hardness, tool wear, and depth and width of cut. With this control, users (via G code) set the spindle load per cut; a warning load level, for when load cannot be kept to an acceptable level (which triggers a warning light, automatic machine safemode, or other function); and an ultimate alarm setting (to automatically shut the machine down). FANUC's CNC product manager Joe Donatoni explains, "Adaptive control has been available for some time, but new adaptive controls monitor spindle cutting load and holds it to a user-defined point by adjusting machine feed override. It's much faster than an operator looking at a load meter and adjusting feedrate manually."

In fact, users interact with a graphing feature that displays both the spindle load and feedrate override versus time. Feedrate control is 100 times finer, to boost responsiveness and accuracy; cycle times are also reduced by up to 40% because every part is optimized in real-time. A torque override feature allows an operator to dynamically modify the adaptive-control setpoint during the machining cycle.iAdaptS also keeps roughing tools fully loaded, putting the heat into the chips rather than the part, thus extending tool life — so there are fewer stoppages.

employed for different digital applications (such as measurement gadgets).

7.DAC (digital to analog converter)–this converter executes opposite functions that ADC perform. This device is generally employed to supervise analog appliances like-DC motors, etc.

8.Interpret Control- This controller is employed for giving delayed control for a working program. The interpret can be internal or external.

9. Special Functioning Block– Some special microcontrollers manufactured for special appliances like - space systems, robots, etc, comprise of this special function block. This special block has additional ports so as to carry out some special operations.

Types of Microcontroller:

Microcontrollers are divided into categories according to their memory, architecture, bits and instruction sets. So let's discuss types of microcontrollers:

Bits:
8 bits microcontroller executes logic & arithmetic operations. Examples of 8 bits micro controller is Intel 8031/8051.

16 bits microcontroller executes with greater accuracy and performance in contrast to 8-bit. Example of 16 bit microcontroller is Intel 8096.

32 bits microcontroller is employed mainly in automatically controlled appliances such as office machines, implantable medical appliances, etc. It requires 32 - bit instructions to carry out any logical or arithmetic function.

Types of Memory:

- External Memory Microcontroller–When an embedded structure is built with a microcontroller which does not comprise of all the functioning blocks existing on a chip it is named as external memory microcontroller. For illustration - 8031 microcontroller does not have program memory on the chip.
- Embedded Memory Microcontroller – When an embedded structure is built with a microcontroller which comprise of all the functioning blocks existing on a chip it is named as embedded memory microcontroller. For illustration - 8051 microcontroller has all program & data memory, counters & timers, interrupts, I/O ports and therefore its embedded memory microcontroller.

Timers / Counters:

8051 has two 16-bit programmable UP timers/counters. They can be configured to operate either as timers or as event counters. The names of the two counters are T0 and T1 respectively. The timer content is available in four 8-bit special function registers, viz, TL0, TH0,TL1 and TH1 respectively. In the "timer" function mode, the counter is incremented in every machine cycle. Thus, one can think of it as counting machine cycles. Hence the clock rate is 1/12th of the oscillator frequency. In the "counter" function mode, the register is incremented in response to a 1 to 0 transition at its corresponding external input pin (T0 or T1). It requires 2 machine cycles to detect a high to low transition. Hence maximum count

Classification of interrupts

1. External and internal interrupts.

External interrupts are those initiated by peripheral devices through the external pins of the microcontroller. Internal interrupts are those activated by the internal peripherals of the microcontroller like timers, serial controller etc.)

2. Maskable and non-maskable interrupts.

The category of interrupts which can be disabled by the processor using program is called maskable interrupts. Non-maskable interrupts are those categories by which the programmer cannot disable it using program.

3. Vectored and non-vectored interrupt.

Starting address of the ISR is called interrupt vector. In vectored interrupts the starting address is predefined. In non-vectored interrputs, the starting address is provided by the peripheral as follows.

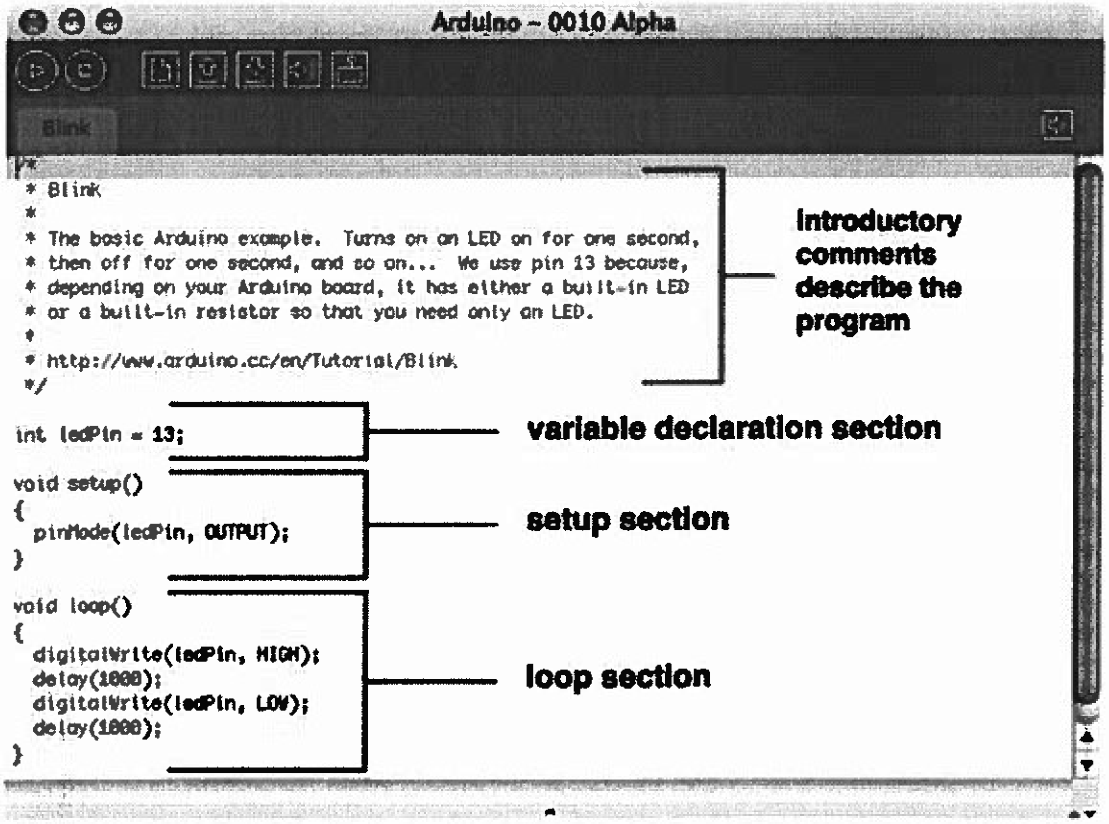
- Microcontroller receives an interrupt request from external device.
- Controller sends an acknowledgement (INTA) after completing the execution of current instruction.
- The peripheral device sends the interrupt vector to the microcontroller.

Embedded Controllers:

Embedded controllers are the general class of microcontrollers used to support OEM-specific implementations. The ACPI specification supports embedded controllers in any platform design, as long as the microcontroller conforms to one of the models described in this section. The embedded controller is a unique feature in that it can perform complex low-level functions through a simple interface to the host microprocessor(s).

Although there is a large variety of microcontrollers in the market today, the most commonly used embedded controllers include a host interface that connects the embedded controller to the host data bus, allowing bi-directional communications. A bi-directional interrupt scheme reduces the host processor latency in communicating with the embedded controller.

Currently, the most common host interface architecture incorporated into microcontrollers is modeled after the standard IA-PC architecture keyboard controller. This keyboard controller is accessed at 0x60 and 0x64 in system I/O space. Port 0x60 is termed the data register, and allows bi-directional data transfers to and from the host and embedded controller. Port 0x64 is termed the command/status register; it returns port status information upon a read, and generates a command sequence to the embedded controller upon a write. This same class of controllers also includes a second decode range that shares the same properties as the keyboard interface by having a command/status register and a data register. The following diagram graphically depicts this interface.



Advantages

- A microcontroller is a cheap and minimal size, easy to carry out. Therefore it can be embedded on any device.
- Programming of microcontrollers is simple to learn. It's not much complicated.
- We can use simulators on a computer to see the practical results of our Microcontrollers Programming. Those we can work on an embedded project with even buying the required components and chips.
- We can virtually see the working of our project of a program.

Lists of Microcontroller Applications

However, they have a lot of use on Microcontrollers. Such as,

1. Mobile Phones
2. Automobiles
3. Cameras
4. Appliances
5. Computer Systems
6. Security Alarms
7. Electronic Measurements Instruments
8. Micro Oven.

Hardware components of PLC

Programmable Logic Controllers continuously monitors the input values from various input sensing devices (e.g. accelerometer, weight scale, hardwired signals, etc.) and produces corresponding output depending on the nature of production and industry. A typical block diagram of PLC consists of five parts namely:

- Rack or chassis
- Power Supply Module
- Central Processing Unit (CPU)
- Input & Output Module
- Communication Interface Module

Rack or Chassis

In all PLC systems, the PLC rack or chassis forms the most important module and acts as a backbone to the system. PLCs are available in different shapes and sizes. When more complex control systems are involved, it requires larger PLC racks.

Small-sized PLC is equipped with a fixed I/O pin configuration. So, they have gone for modular type rack PLC, which accepts different types of I/O modules with sliding and fit in concept. All I/O modules will be residing inside this rack/chassis.

Power Supply Module

This module is used to provide the required power to the whole PLC system. It converts the available AC power to DC power which is required by the CPU and I/O module. PLC generally works on a 24V DC supply. Few PLC uses an isolated power supply.

CPU Module and Memory

CPU module has a central processor, ROM & RAM memory. ROM memory includes an operating system, drivers, and application programs. RAM memory is used to store programs and data. CPU is the brain of PLC with an octal or hexagonal microprocessor.

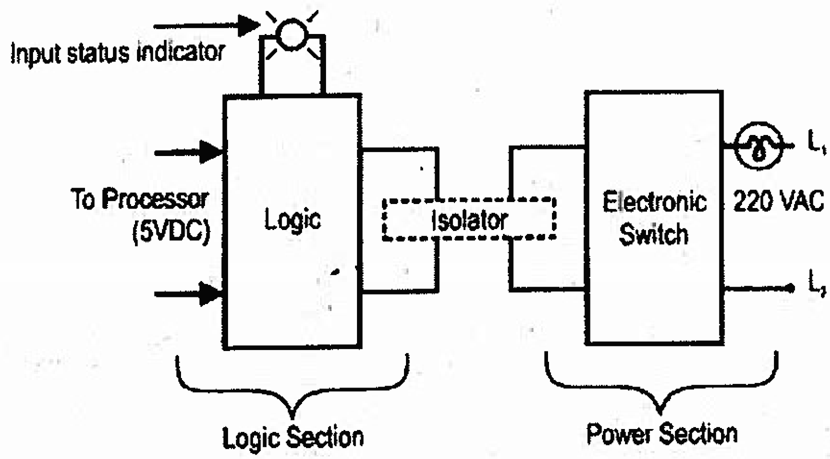
Being a microprocessor-based CPU, it replaces timers, relays, and counters. Two types of processors as a single bit or word processor can be incorporated with a PLC. One bit processor is used to perform logic functions. Whereas word processors are used for processing text, numerical data, controlling, and recording data.

CPU reads the input data from sensors, processes it, and finally sends the command to controlling devices. DC power source, as mentioned in the previous discussion is required voltage signals. CPU also contains other electrical parts to connect cables used by other units.

Input and Output Module

Have you ever thought about how to sense physical parameters like temperature, pressure, flow, etc? using PLC? Of course, PLC has an exclusive module for interfacing inputs and output, which is called an input & output module.

Input devices can be either start and stop pushbuttons, switches, etc and output devices can be an electric heater, valves, relays, etc. I/O module helps to interface input and output devices with a microprocessor. The input module of PLC is explained in the below figure.



PLC Output Module

So, here when the program logic high signal is generated from the processor, the LED will turn ON and allow the light to fall on a phototransistor. When the transistor goes to the conduction region, it generates a pulse to the gate of the Triac. The isolator block is used to isolate the logic section and control section.

Communication Interface Module

To transfer information between CPU and communication networks, intelligent I/O modules are used. These communication modules help to connect with other PLCs and computers which are placed at a remote location.

Types of PLCs

The two main types of PLC are fixed / compact PLC and modular PLC.

Compact PLC

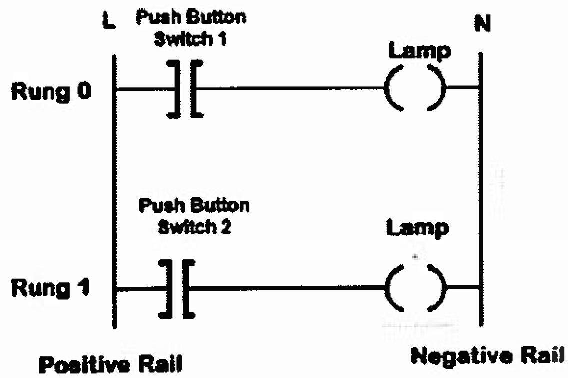
Within a single case, there would be many modules. It has a fixed number of I/O modules and external I/O cards. So, it does not have the capability to expand the modules. Every input and output would be decided by the manufacturer.

Modular PLC

This type of PLC permits multiple expansion through "modules", hence referred to as Modular PLC. I/O components can be increased. It is easier to use because each component is independent of each other.

PLC are divided into three types based on output namely Relay output, Transistor output, and Triac Output PLC. The relay output type is best suited for both AC and DC output devices. Transistor output type PLC uses switching operations and used inside microprocessors.

According to the physical size, a PLC is divided into Mini, Micro, and Nano PLC.



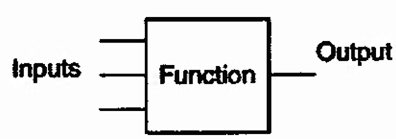
PLC Ladder Logic

In the above-mentioned example, two pushbuttons are used to control the same lamp load. When any one of the switches is closed, the lamp will glow.
The two horizontal lines are called rungs and the two vertical lines are called rails. Every rung forms the electrical connectivity between Positive rail (P) and Negative rail (N). This allows the current to flow between input and output devices.

Functional Block Diagrams

Functional Block Diagram (FBD) is a simple and graphical method to program multiple functions in PLC. PLCOpen has described using FBD in the standard IEC 61131-3. A function block is a program instruction unit that, when executed, yields one or more output values.

It is represented by a block as shown below. It is represented as a rectangular block with inputs entering on left and output lines leaving at the right. It gives a relation between the state of input and output



Function Block

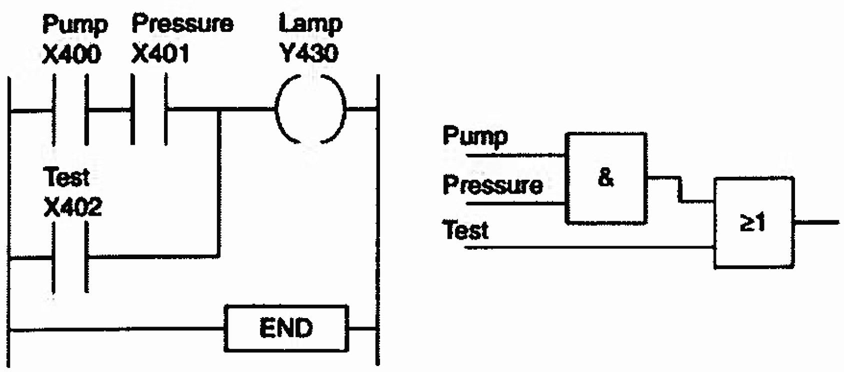
The advantage of using FBD is that any number of inputs and outputs can be used on the functional block. When using multiple input and output, you can connect the output of one function block to the input of another. Whereby building a **Function Block Diagram**.

The figure below shows various function blocks used in FBD programming.

PLC Programming Examples

A signal lamp is required to be switched on if a pump is running and the pressure is satisfactory, or if the lamp test switch is closed. In this application, if there should be an output from the lamp inputs from both pump and pressure sensors are required. Hence, AND logic gates are used.

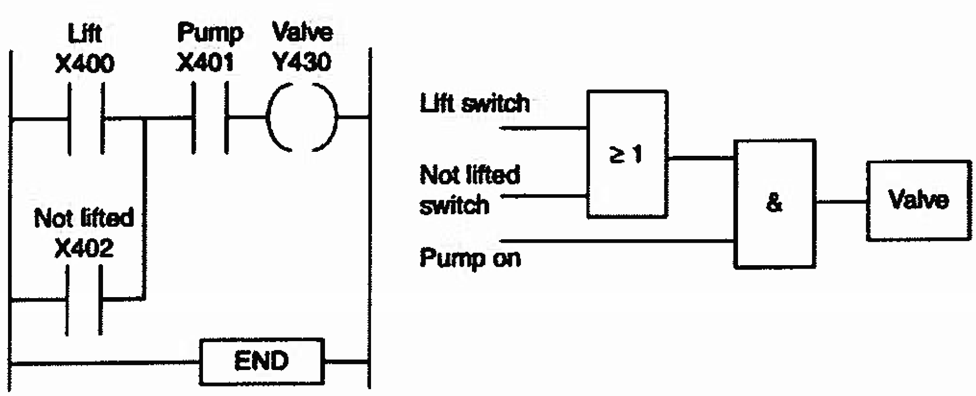
OR logic is used for the test input condition, it is required to give an output of lamp on regardless of whether there is a signal from the AND system. By using END or RET instruction in the ladder diagram, we can tell PLC has reached the end of the program. The function block diagram and the ladder diagram are shown below in the figure.



PLC Program to Test Lamp Glowing

As another example, consider a valve that is to be operated to lift a load when a pump is running and either the lift switch is operated or a switch operated indicating that the load has not already been lifted and is at the bottom of its lift channel.

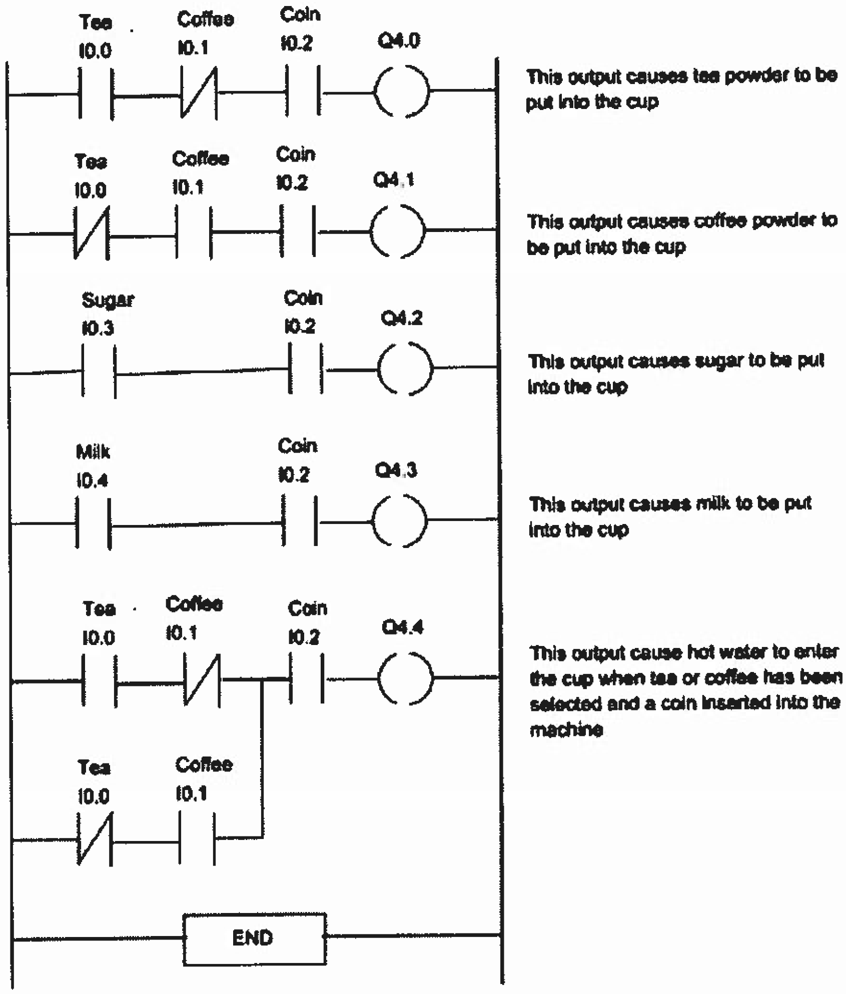
OR logic is used for two switches and an AND logic is used with two switches and the pump. Valve will be operated only if the pump is ON and two switches are operated.



PLC Program to Operate Valve

Consider a drinks machine that allows the selection of tea or coffee, milk or no milk, sugar or no sugar, and will supply the required hot drink on the insertion of a coin. From the below-shown figure, it is seen that either tea or coffee is selected using the first OR logic gate.

The first AND gate give an output when either Tea or coffee is selected and a coin is



Ladder Logic for Drinking Machine Application

14. Important Questions/Question Bank

Branch		ME- IV Year I sem				
Subject		CNC Technology				
UNIT-I			Marks	CO	PO	BTL
1	A	Explain clearly the difference between NC and CNC machine.	2	1	1	1
	B	How does the structure of NC/CNC machine tools differ from conventional machine tools?	3	1	2	1
	C	Classify CNC machines tools on the basis of : (i) Types of motion control (ii) According to programming Method.(iii) According to types of controllers	10	1	2	2
2	A	State advantages and limitations of CNC machine tools.	2	1	1	1
	B	Describe with sketch the working and construction of recirculating ball screw used in CNC machine tools.	3	1	1	2
	C	Classify NC systems, point to point, NC and CNC, incremental and absolute, open and closed loop systems.	10	1	2	2
3	A	What are canned cycles? Discuss how a canned cycle is useful in writing a part program?	2	1	1	1
	B	Explain cutter radius compensation and tool length compensation.	3	1	2	1
	C	Write a CNC program using appropriate G and M code to turn component as Shown in figure (1). Raw material: MS Φ32 X 50 mm, cutting speed V= 40 m/min and feed=0.1, Assume suitable data for depth of cut	10	1	1	2
4	A	Define numerical control machine.	2	1	1	1
	B	State various automated programmed tool languages.	3	1	1	1
	C	Develop a CNC program, using G and M code, to cut a slot for the component shown in fig.1 by using an end mill of diameter 6mm. The depth of slot is 5mm. Assume suitable data for speed, feed, etc.	10	1	1	2
5	A	What is NC part programming?	2	1	1	1
	B	What is manual part programming? And how it is differ from part program?	3	1	1	1
	C	What is the features of NC Machine tools and design consideration of NC machine tool	10	1	1	2
UNIT-II						
1	A	What is NC part programming?	2	2	1	2
	B	What is interchangeable tooling system	3	2	1	2
	C	Briefly explain CNC Machine elements with suitable diagram.	10	2	1	1

6	A	What are the advantages of using indexible inserts in CNC machines?	2	2	1	1
	B	Explain NC programming on CAD/CAM systems.	3	3	1	1
	C	What is Automatic Tool Path generation and briefly explain the design and implementation of post processors	10	3	1	2
UNIT-IV						
1	A	What are the various characteristic of cutting tools materials of CNC machine?	2	3	1	1
	B	What are common problems in? (i) Mechanical components of CNC (ii) Electrical components of CNC.	3	3	1	3
	C	Explain different types of DNC systems, advantages and disadvantages of DNC system.	10	3	2	4
2	A	What are the different types of part programming formats?	2	4	1	2
	B	What is DNC Systems and Adaptive Control?	3	4	1	2
	C	Distinguish between Model and no model code. Explain with example. Differentiate between absolute programming and incremental programming.	10	4	2	4
3	A	Write the basic structure of the part program with example?	2	4	1	1
	B	Why the repetitive programming is used? Explain its various types.	3	4	1	
	C	Briefly explain adaptive control of machining processes like turning, grinding.	10	4	3	1
4	A	Distinguish between G code and M code.	2	4	1	
	B	What is adaptive control with constraints	3	4	1	2
	C	How a closed loop control system is more advantageous as compared to an open-loop control system?	10	4	1	2
5	A	What is adaptive control with optimization?	2	4	1	
	B	Explain the function of MCU in an NC tooling and Conventional tooling.	3	4	1	2
	C	What is meant by interpolation? How is it implemented on an NC machine tool?	10	4	1	
UNIT-V						
1	A	What are the essential elements of a PLC system?	2	4	1	
	B	Define PLC. Discuss the relay device components used in it.	3	4	1	
	C	What is a PLC? Explain major components of a PLC. List various applications of PLC	10	4	1	
2	A	Draw and explain PLC architecture.	2	4	1	
	B	Explain the steps of automatic tool changing in an NC machining Centre.	3	4	1	

17. Individual Time Table

Sec.-A

Faculty Name	Mr.HAMED KHAN					Subject: CNC TECH		
Days↓	**9:30-10:20**	**10:20-11:10**	**11:10-12:00**	**12:00-12:50**	**LUNCH**	**1:40-2:30**	**2:30-3:20**	**3:20-4:10**
MON								
TUE								
WED	**CNC TECH**							
THUR			**CNC TECH**					
FRI								
SAT								

Sec.-B

Faculty Name	Mr.ABDUL SAMAD					Subject: CNC TECH		
Days↓	**9:30-10:20**	**10:20-11:10**	**11:10-12:00**	**12:00-12:50**	**LUNCH**	**1:40-2:30**	**2:30-3:20**	**3:20-4:10**
MON								
TUE								
WED	**CNC TECH**					**CNC TECH**		
THUR			**CNC TECH**					
FRI								
SAT								

Sec.-C

Faculty Name	Mr.MANSOOR HASAN					Subject: CNC TECH		
Days↓	**9:30-10:20**	**10:20-11:10**	**11:10-12:00**	**12:00-12:50**	**LUNCH**	**1:40-2:30**	**2:30-3:20**	**3:20-4:10**
MON								
TUE								
WED	**CNC TECH**							
THUR							**CNC TECH**	
FRI								
SAT								

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
TIME TABLE

Acadmic year: 2019-2020 **Year-Semester:** IV-I-A
Course: B.Tech **Room No. :** C-III LH:1

	9:30 to10:20	10:20 to11:10	11:10 to 12:00	12:00 to12:50	12:50 to1:40	1:40 to 2:30	2:30 to 3:20	3:20 to 4:10
MONDAY	PPE		ICS		L U N C H B R E A K	CAD/CAM LAB/ ICS LAB		
TUESDAY	ICS		PPE			LIBRARY		
WEDNESDAY	CNC TECH		CAD/CAM			CAD/CAM LAB/ ICS LAB		
THURSDAY	AMT		CNC TECH			SEMINAR		
FRIDAY	AMT		CAD/CAM			MINI PROJECT		
SATURDAY	SPORTS					LIABARY/TPO		

THEORY:

POWER PLANT ENGG (PPE)	Dr.KM MEHBOOB SHERIF
CAD/CAM	Mr. MANSOOR HASSAN
INSTRUMENTATION AND CONTROL SYSTEM (ICS)	Mr.KHAJA ALI
CNC TECH	Mr.HAMED KHAN
ADDITIVE MANUFACTURING TECH (AMT)	Mr. YOUSUF ALI

LABS:

CAD/CAM LAB	Mrs.MANSOOR HASSAN(K)/Mr.SIRAJ
INSTRUMENTATION AND CONTROL SYSTEM (ICS LAB)	Mr.MUSTAQ AHMED/Mr.IRFAN
SEMINAR	Dr. MAGBUL /Mr.SHAKEEL
MINI PROJECT	Dr. ZAHIR/Mr.AZFAR HASHMI

HOD

PRINCIPAL

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY

DEPARTMENT OF MECHANICAL ENGINEERING

TIME TABLE

Acadmic year: 2019-2020

Course: B.Tech

Year-Semester: IV-I-B

Room No. : C-III LH:2

	9:30 to10:20	10:20 to11:10	11:10 to 12:00	12:00 to12:50	12:50 to1:40	1:40 to 2:30	2:30 to 3:20	3:20 to 4:10
MONDAY	PPE		ICS		LUNCH BREAK	MINI PROJECT		
TUESDAY	ICS		PPE			LIBRARY		
WEDNESDAY	CNC TECH	CAD/CAM LAB/ ICS LAB				CNC TECH	CAD/CAM	
THURSDAY	AMT		CNC TECH			CAD/CAM LAB/ ICS LAB		
FRIDAY	AMT		CAD/CAM			LIBRARY		
SATURDAY	SPORTS					LIABARY/TPO		

THEORY:

POWER PLANT ENGG (PPE)	Dr. MOHAMMED NASRULLAH
CAD/CAM	Mrs. SARTAZ
INSTRUMENTATION AND CONTROL SYSTEM	Dr. VASANTH KUMAR
CNC TECH	Mr.ABDUL SAMAD
AMT	Mr.HAROON BAIG

LABS:

CAD/CAM LAB	Mrs.MANSOOR HASSAN(H)/Mr.M.A MOYEED
INSTRUMENTATION AND CONTROL SYSTEM (ICS LAB)	Mr. MUSHATAQ I /Mr. SANAGAMESH
SEMINAR	Dr. KM MEHBOOB /Mr. P.RAMULU
MINI PROJECT	Dr. VASANTH KUMAR /Mrs.SARTAZ

HOD

PRINCIPAL

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY
DEPARTMENT OF MECHANICAL ENGINEERING
TIME TABLE

Acadmic year: 2019-2020

Course: B.Tech

Year-Semester: IV-I-C

Room No. : C-III LH:2

	9:30 to10:20	10:20 to11:10	11:10 to 12:00	12:00 to12:50	12:50 to1:40	1:40 to 2:30	2:30 to 3:20	3:20 to 4:10
MONDAY	PPE		ICS		L	MINI PROJECT		
TUESDAY	ICS	SEMINAR			U	CAD/CAM LAB/ ICS LAB		
WEDNESDAY	CNC TECH		CAD/CAM		N C H	ICS	PPE	
THURSDAY	AMT	LIBARAY			B	AMT	CNC TECH	
FRIDAY	AMT		CAD/CAM		R E	CAD/CAM LAB/ ICS LAB		
SATURDAY	SPORTS				A K	LIABARY/TPO		

THEORY:

POWER PLANT ENGG (PPE)	Mrs.PRATIMA JOSHI
CAD/CAM	Mr.AQEEL AHMED
INSTRUMENTATION AND CONTROL S	Mr.ABDUL JABBAR
CNC TECH	Mr.MANSOOR HASAN
AMT	Mrs.TASLEEM BANU

LABS:

CAD/CAM LAB	Mrs.AZFAR HASHMI/Mr.SYED AMER
INSTRUMENTATION AND CONTROL SYSTEM (ICS	Mr. UMAIR /Mr. IRFAN KHAN
SEMINAR	Mr.RAZA AHMED KHAN
MINI PROJECT	Dr. MOHAMMED NASRULLAH/Dr.MUJAHED

HOD

PRINCIPAL

19. Assignment questions

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
New Malakpet, Hyderabad 500024

Assignment Questions-1

Q.No	Questions	Bloom's Level & CO
1	How an N / C machine tool is different from a conventional machine tool.	L1, CO1
2	Define Numerical Control. What are the different components of an N/ C system?	L1, CO1
3	What is direct numerical control? How it is different from computerized Numerical Control (CNC).	L1, CO1
4	Differentiate between NC, DNC and CNC.	L2, CO1
5	List some characteristics that are desirable for a component to be machined on a CNC system.	L4, CO1
6	List the advantages of CNC. How CNC is different from NC?	L4, CO2
7	How the conventional machine tools and CNC machine tool is different in design and construction.	L1, CO2
8	What is interchangeable tooling system	L1, CO2
9	What is interchangeable tooling system, preset and qualified tools, coolant fed tooling system	L2, CO2
10	What is quick-change tooling system and automatic head changers.	L1, CO2

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
New Malakpet, Hyderabad 500024

Assignment Questions-2

Q.No	Questions	Bloom's Level & CO
1	Define part programming. Differentiate between manual part programming and computer aided part programming.	L2, CO3
2	What are the different types of part programming formats?	L1, CO3
3	Write the basic structure of the part program with example?	L2, CO3
4	Distinguish between Model and no model code. Explain with example.	L4, L2, CO3
5	Differentiate between absolute programming and incremental programming.	L2, CO3
6	Why the repetitive programming is used? Explain its various types.	L2, CO4
7	Define PLC. Discuss the relay device components used in it.	L2, CO4
8	How a closed loop control system is more advantageous as compared to an open-loop control system?	L2, CO4
9	Distinguish between G code and M code.	L4, CO4
10	What is difference between Micro Controllers, Embedded Controllers? Write applications and Programming of Micro Controllers.	L1, CO4

20. University Question Papers of Previous Years

Question Paper Code : 91

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014

Fifth Semester

Mechatronics Engineering

ME 83101/080210024 — CNC TECHNOLOGY

(Regulation 2008)

Time : Three hours — Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define NC Machine tool.
2. What do you mean by fixed zero and floating zero?
3. How is backlash error compensated in the CNC machine.
4. List the functions of timing belt in the CNC machine.
5. State the role of sensor in the CNC machine.
6. What do you mean by cutter radius compensation?
7. Define subroutine.
8. State the benefits of using CAM packages in the CNC machines.
9. How to improve the CNC machine life?
10. State the merits of using CNC machines.

PART B — (5 × 16 = 80 marks)

11. (a) Discuss the various classifications of CNC machines with necessary illustrations. (16)

Or

(b) (i) Describe the various elements of CNC machine. (8)

(ii) Discuss the CNC coordinate method with neat diagram. (8)

7E 7018

Roll No. ____________________ [Total No. of Pages : 2

7E 7018

B.Tech. VII Semester (Main) Examination, Dec. - 2015
Mechanical Engineering
7ME6.3A CNC Machines and Programming
ME&PI

Time : 3 Hours

Maximum Marks : 80
Min. Passing Marks : 24

Instructions to Candidates:

Attempt any five questions, selecting one question from each unit. All questions carry equal marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly).

Unit - I

1. a) Define NC, CNC. Also explain their developments and improvements in their applications. **(8)**

   b) Compare NC machines with conventional machines and write down advantages of NC machines over conventional machines. **(8)**

OR

1. a) Define Automation. What are different types of Automation? Compare hard automation and soft automation. **(10)**

   b) Write down applications of Numerical control machines. **(6)**

Unit - II

2. a) Write down various design consideration of NC machines. **(6)**

   b) How many type of drive can be used in NC system ? Also write down about spindle and feed drive. **(10)**

OR

2. a) What do you meant by Architecture of NC system? Describe it briefly **(6)**

   b) Define sensors and their applications in Numerical control machines? Also write various types of sensors. **(10)**

Unit - III

3. a) "Use of canned cycle reduce the length of a manual part program". Justify this statement with suitable example. **(12)**

   b) What is the format of a block in manual part programming? **(4)**

OR

3. a) Write down the syntax for defining a geometry in computer- assisted part programming. Also name the four types of statements in a complete APT part program. **(10)**

   b) Define Automatic part program generation. **(6)**

Unit - IV

4. Write short notes on

   a) CAPP systems. **(8)**

21. Mid Wise Question Papers, Quiz Questions, Key Answers

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
New Malakpet, Hyderabad 500024
IV-I SEMESTER B.TECH MID-I EXAMINATION September 2019

BRANCH: Mechanical Engineering
SUBJECT: CNC Technology

Date: 16/09/2019
Time: 60 minutes

I. Answer any two of the following questions.
2X5=10

Q.No	Questions	Bloom's Level	CO maping
1.	a) What are the advantages of NC system? b) Classify NC system?	L1, L2	CO1
2.	a) Distinguish point to point and continuous path CNC control. b) What is feed drive? Explain Mechanical transmission system in feed drive?	L3, L1	CO1
3.	a) What is interchangeable tooling system? b) Compare coolant fed tooling system and modular tooling system?	L1, L2	CO2
4.	a) What are G and M codes? b) State the significance of – G01, G04, M06 and M03 in part programming.	L1, L2	CO2

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
IV B.Tech. I Sem., I Mid-Term Examinations, September-2019
CNC Technology
Objective Exam

Name: ______________________ **Hall Ticket No.** [| | | | | | | | | |]

Answer All Questions. All Questions Carry Equal Marks. **Time: 20 Mints. Marks 10**

I. Choose the Correct alternative:

1) The depth that the tool is plunged into the surface is called as ______ [ ]

a) feed b) depth of cut

c) depth of tool d) working depth

2) Feed is measured in units of _____ [ ]

a) length/revolution b) degree/revolution

c) length d) velocity

3) CNC machining centers do not include operations like ______ [ ]

a) milling b) boring

c) welding d) tapping

4) In how many ways CNC machine tool systems can be classified? [ ]
a) 2 b) 3
c) 4 d) 5

5) CNC system when first commercially introduced around [ ]
a) 1952 b) 1968
c) 1970 d) 1975

6) G-codes are used as _____ functions. [ ]
a) Miscellaneous b) Preparatory
c) Machine d) Work piece

7) Spindle speed for CNC machining centre is always specified in: [ ]
a) Surface feet or Meters per minute b) Inches per minute
c) RPM d) Inches per revolution

8) Miscellaneous commands are programmed using [ ]
a) T Words b) G Words
c) X Words d) M words

9) In a turning centre program, M05 means [ ]
a) Program end b) Spindle Stop
c) Coolant ON d) Tool change

10) G70 cycle in turning centre is used for [ ]
a) Finish turning b) Thread cutting
c) Rough turning d) Tapping

Cont…..2

CNC Technology
Mid-I Exam Keys

I. Choose the correct alternative:

1. B
2. A
3. C
4. C
5. C
6. B
7. C
8. D
9. B
10. A

II. Fill in the blanks:

11. Part program.
12. Data processing unit (DPU) and control loops unit.
13. Cutting speed.
14. Hydrostatic guide way.
15. Direct current and alternating current.
16. Presetting.
17. Preset and qualified tooling.
18. Cutting Speed.
19. Canned.
20. Tape punch.

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

New Malakpet, Hyderabad 500024

IV-I SEMESTER B.TECH MID-II EXAMINATION November 2019

BRANCH: Mechanical Engineering
SUBJECT: CNC Technology

Date: 22/11/2019
Time: 60 minutes

I. Answer any two of the following questions. **2X5=10**

Q.No	Questions	Bloom's Level & CO

1. a) Prepare a complete manual part program for the figure shown. This part is to be machined from a rolled stock of 40mm diameter.

Process plan for the component is

Operation	Description	Tools	Cutting speed m/min	Feed mm/min
10	Facing	T01,Facing Tool	200	0.30
20	Roughing Turning	T02,Roughing Tool	200	0.35
30	Finish Turning	T03,Finishing Tool	300	0.20

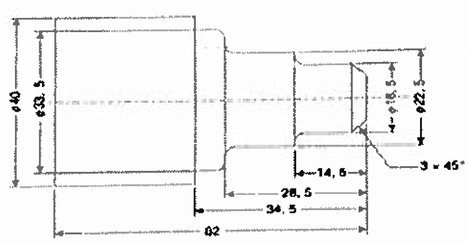


Fig. 14.16 *Part drawing to be used as an example for cut planning for a turned component*

b) Explain the four types of statements in a complete APT part program.

L5, L2, CO3

2. a) Prepare a complete APT part program for the following component shown in figure using an end mill cutter of 20mm diameter. Clearly show the axes system chosen with a sketch and the direction of the cutter for the motion statements.

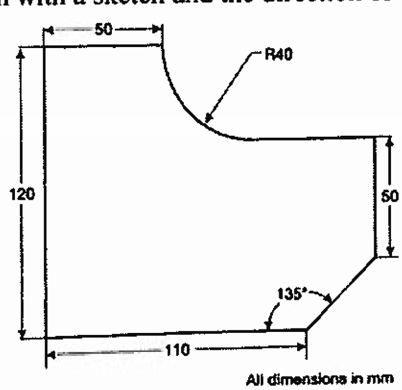


Fig. 16.43 *Part drawing for Example 16.11*

b) Define Automatic tool path generation using CAD/CAM.

L5, L1, CO3

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
IV B.Tech. I Sem., II Mid-Term Examinations, November-2019
CNC Technology
Objective Exam

Name: ______________________ **Hall Ticket No.** [| | | | | | | | |]

Answer All Questions. All Questions Carry Equal Marks. **Time: 20 Mints. Marks 10**

II. Choose the Correct alternative:

1) DNC system uses ______communication system. [ ]

a) single way b) two way

c) three way d) none

2) _____is omitted in DNC system [ ]

a) tape reader b) central computer

c) control unit d) part program

3) How many temporary storage buffers are used in BTR system ______ [ ]

a) one b) four

c) two d) six

4) In adaptive control system________ is automatically adopted. [ ]
a) speed b) feed
c) both a,b d) none of the above

5) Adaptive control with optimization is a _____ control system. [ ]
a) Open loop b) closed loop
c) Both a,b d) none of the above

6) Online measurement of _____ is the drawback of ACO [ ]
a) Tool wears b) speed
c) Feed rate d) tool temperature

7) Benefit of adaptive control system [ ]
a) Increase production rate b) increased tool life
c) Less operator intervention d) all the above

8) The potentiometer is a variable _____ divider [ ]
a) Current b) voltage
c) Temperature d) resistance

9) Numeric display consists of ______ rectangular LED [ ]
a) 5 b) 6
c) 7 d) 8

10) for 8031/8051microcontroller what is the maximum power dissipation rating? [ ]
a) 5W ` b) 10W
c) 2W d) 1W

Cont…..2

CNC Technology
Mid-II Exam Keys

III. Choose the correct alternative:

21.B
22.A
23.C
24.C
25.B
26.A
27.D
28.B
29.C
30.D

IV. Fill in the blanks:

31.Central computer.
32.Finishing.
33.Photo diodes /photo transister
34.Assembler.
35.Buses.
36.Timer/counter
37.Speed and position.
38.Constant.
39.Interrupt.
40.8 bit true bi directional

Student List

S. No.	Roll No.	Student Name	Mid-1 Total (25M)
1	16RT1A0302	ABDULLAH MOHD HASHIR	22
2	16RT1A0303	AHMED ADNAN UL HUDA	18
3	16RT1A0307	M A TAYYAB	22
4	16RT1A0308	MD BILAL ANSARI	20
5	16RT1A0309	MD JAMEEL AHMED SHAKEEL	20
6	16RT1A0310	MD KHAJA QUTUB UDDIN NAWAZ	24
7	16RT1A0311	MD MAHBOOB KHAN	23
8	16RT1A0313	MD MUZAFFAR ULLAH KHAN	24
9	16RT1A0322	MOHAMMED ABDUL SHUKOOR	25
10	16RT1A0325	MOHAMMED AHSAN ALI	22
11	16RT1A0326	MOHAMMED ARSHAD HUSSAIN	25
12	16RT1A0328	MOHAMMEA ASIM UDDIN	24
13	16RT1A0329	MOHAMMED ATIF	23
14	16RT1A0331	MOHAMMED FAIZAN AHMED	21
15	16RT1A0333	MOHAMMED HABEEBULLAH SHAREEF	24
16	16RT1A0334	MOHAMMED HASSAN KHAN	24
17	16RT1A0337	MOHAMMED KHUNDMIR MEHDI	24
18	16RT1A0347	MOHAMMED SOHAIL	24
19	16RT1A0348	MOHAMMED UZAIR AHMED	23
20	16RT1A0349	MOHAMMED ZAID	23
21	16RT1A0350	MOHAMMED ZOHAIB RASHEED	20
22	16RT1A0351	MOHAMMED ZUHAIB ALI	23
23	16RT1A0354	MOHD ABDUL BASITH	21
24	16RT1A0359	MOHD ABDUL KHADER	23
25	16RT1A0363	MOHD FAIZ AHMED	24
26	16RT1A0364	MOHAMMED FAZAL UDDIN JUNIADI	22
27	16RT1A0365	MOHD FAIZUL HAQUE	21
28	16RT1A0370	MOHAMMED IBRAHIM	18

59	17RT5A0318	MOHD ASHWAQ	14
60	17RT5A0319	MOHD JAVEED ALI	16
61	17RT5A0320	MOHD MOIZE	15
62	17RT5A0322	MOHD NADEEM UDDIN	22
63	17RT5A0324	MOHAMMED FURQAN HUSSAIN	22
64	17RT5A0331	SYED GHOUSE	15
65	17RT5A0332	SYED MUKHTARUDDIN	18
66	17RT5A0333	SYED NOUMAN ALI SUFIYAN	22
67	17RT5A0334	SYED PARVEZ	17
68	17RT5A0335	SYED RASHED	16

22.1 Student List with Advanced Learners on the Basis of CNC TECH MID-1 Exam

S. No.	Roll No.	Student Name	Mid-1 Total (25M)
1	16RT1A0302	ABDULLAH MOHD HASHIR	25
2	16RT1A0303	AHMED ADNAN UL HUDA	22
3	16RT1A0307	M A TAYYAB	25
4	16RT1A0308	MD BILAL ANSARI	23
5	16RT1A0309	MD JAMEEL AHMED SHAKEEL	23
6	16RT1A0310	MD KHAJA QUTUB UDDIN NAWAZ	25
7	16RT1A0311	MD MAHBOOB KHAN	23
8	16RT1A0313	MD MUZAFFAR ULLAH KHAN	25
9	16RT1A0322	MOHAMMED ABDUL SHUKOOR	25
10	16RT1A0326	MOHAMMED ARSHAD HUSSAIN	24
11	16RT1A0328	MOHAMMEA ASIM UDDIN	23
12	16RT1A0329	MOHAMMED ATIF	23
13	16RT1A0331	MOHAMMED FAIZAN AHMED	22
14	16RT1A0333	MOHAMMED HABEEBULLAH SHAREEF	24
15	16RT1A0334	MOHAMMED HASSAN KHAN	24
16	16RT1A0337	MOHAMMED KHUNDMIR MEHDI	23
17	16RT1A0347	MOHAMMED SOHAIL	24
18	16RT1A0348	MOHAMMED UZAIR AHMED	24
19	16RT1A0349	MOHAMMED ZAID	22
20	16RT1A0350	MOHAMMED ZOHAIB RASHEED	23
21	16RT1A0351	MOHAMMED ZUHAIB ALI	23
22	16RT1A0354	MOHD ABDUL BASITH	22
23	16RT1A0359	MOHD ABDUL KHADER	23
24	16RT1A0363	MOHD FAIZ AHMED	23
25	16RT1A0364	MOHAMMED FAZAL UDDIN JUNIADI	23
26	16RT1A0365	MOHD FAIZUL HAQUE	24
27	16RT1A0378	MOHD MISBAHUDDIN MUJEEB	22
28	16RT1A0379	MOHAMMED MUFFAKHAM MUNTAJIB UDDIN	22
29	16RT1A0385	MOHD SALMAN MOIZ	22
30	16RT1A0388	MOHD YOUNUS	23
31	16RT1A0390	MOHD ZEESHAN ADAN	24
32	16RT1A0391	MUSHTAQ AHMED	22

22.2 Student List with Slow Learners on the Basis of CNC TECH MID-1Exam

S. No.	Roll No.	Student Name	Mid-1 Total (25M)
1	16RT1A0325	MOHAMMED AHSAN ALI	21
2	16RT1A0370	MOHAMMED IBRAHIM	21
3	16RT1A0372	MOHD JAFFER	20
4	16RT1A0396	SHAIK MUJAHED	21
5	16RT5A0306	MOHAMMED BARKATH ALI	21
6	17RT5A0301	ABDUL AZEEM	21
7	17RT5A0305	MD LUKMAN	21
8	17RT5A0308	MD ZUBAIRUDDIN	21
9	17RT5A0310	MOHAMMAD ADNAN	21
10	17RT5A0318	MOHD ASHWAQ	17

23. CO & PO Attainment

0 – 21
14 – 20
6

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY, JNTUH Hyderabad
DEPARTMENT OF MECHANICAL ENGINEERING

B.Tech. IV YEAR, I SEM - ATTAINMENT CALCULATIONS - Academic Year: 2019-20

C-Technology   Subject Code: C16414   Faculty: DR. NOOR ALAM

	MID -1											MID -2											MID		SEE
Hall Ticket No.	ASG-1 (2.5M)	ASG-2 (2.5 M)	Quiz-1 (10 M)		Q 1 (5 M)	Q 2 (5 M)	BEST OF Q1&Q2	Q 3 (5 M)	Q 4 (5 M)	BEST OF Q3&Q4	Mid-1 TOTAL	ASG-3 (2.5M)	ASG-4 (2.5 M)	Quiz-2 (10 M)		Q 1 (5 M)	Q 2 (5 M)	BEST OF Q1&Q2	Q 3 (5 M)	Q 4 (5 M)	BEST OF Q3&Q4	Mid-2 TOTAL	Average MID	TOTAL Marks	End Exam
	C01	C02	C01	C02	C01	C01	C01	C02	C02	C02	(25 M)	C03	C04	C03	C04	C03	C03	C03	C04	C04	C04	(25 M)	(25 M)	(100 M)	(75 M)
16RT1A0302	2.5	2.5	5	5		5	5	5		5	25	2.5	2.5	5	5	2		2		5	5	22	24	59	36
16RT1A0303	2	2	5	5		4	4		4	4	22	1.5	1.5	5	5	1		1	4		4	18	20	49	29
16RT1A0307	2.5	2.5	5	5	5		5		5	5	25	2.5	2.5	5	5		2	2	5		5	22	24	59	36
16RT1A0308	2.5	2.5	5	5	4		4	4		4	23	2.5	2.5	5	5		1	1	4		4	20	22	49	28
16RT1A0309	2.5	2.5	5	5		4	4	4		4	23	2.5	2.5	5	5		1	1	4		4	20	22	59	38
16RT1A0310	2.5	2.5	5	5		5	5		5	5	25	2.5	2.5	5	5	4		4		5	5	24	25	59	35
16RT1A0311	2.5	2.5	5	5	4		4		4	4	23	2	2	5	5	4		4		5	5	23	23	59	36
16RT1A0313	2.5	2.5	5	5	5		5	5		5	25	2	2	5	5	5		5	5		5	24	25	69	45
16RT1A0322	2.5	2.5	5	5		5	5	5		5	25	2.5	2.5	5	5		5	5	5		5	25	25	59	34
16RT1A0325	2.5	2.5	5	3	4		4	4		4	21	2.5	2.5	5	5		2	2	5		5	22	22	49	28
16RT1A0326	2.5	2.5	5	5	4		4		5	5	24	2.5	2.5	5	5	5		5		5	5	25	25	59	35
16RT1A0328	2.5	2.5	5	5		4	4		4	4	23	2.5	2.5	4	5	5		5	5		5	24	24	59	36
16RT1A0329	2	2	5	5		5	5	4		4	23	2	2	5	5		4	4	5		5	23	23	39	16
16RT1A0331	2	2	5	5		4	4	4		4	22	2	2	5	5		2	2		5	5	21	22	39	18
16RT1A0333	2.5	2.5	5	5	5		5		4	4	24	2.5	2.5	4	5		5	5		5	5	24	24	59	35
16RT1A0334	2.5	2.5	5	5	4		4		5	5	24	2.5	2.5	5	5		4	4	5		5	24	24	69	45
16RT1A0337	2.5	2.5	5	5		4	4		4	4	23	2.5	2.5	4	5	5		5	5		5	24	24	59	36
16RT1A0347	2.5	2.5	5	5		5	5	4		4	24	2.5	2.5	4	5	5		5		5	5	24	24	59	35
16RT1A0348	2.5	2.5	5	5	4		4	5		5	24	2.5	2.5	4	5		4	4		5	5	23	24	59	36
16RT1A0349	2	2	5	5	4		4		4	4	22	2	2	5	5		4	4	5		5	23	23	39	17
16RT1A0350	2.5	2.5	5	5		4	4	4		4	23	2	2	5	5	1		1	5		5	20	22	49	28
16RT1A0351	2.5	2.5	5	4		4	4		5	5	23	2.5	2.5	4	5	4		4	5		5	23	23	69	46
16RT1A0354	2.5	2.5	5	4		4	4	4		4	22	2.5	2.5	5	5		1	1		5	5	21	22	39	18
16RT1A0359	2.5	2.5	5	5	5		5	3		3	23	2.5	2.5	4	5		4	4		5	5	23	23	69	46
16RT1A0363	2.5	2.5	5	5	4		4	4		4	23	2.5	2.5	5	5		4	4	5		5	24	24	59	36
16RT1A0364	2	2	5	5		4	4		5	5	23	2	2	5	5	3		3		5	5	22	23	49	27
16RT1A0365	2.5	2.5	5	5		5	5	4		4	24	2	2	5	5		2	2		5	5	21	23	39	17
16RT1A0370	2.5	2.5	5	5		3	3	3		3	21	2	2	4	5		2	2		3	3	18	20	59	40
16RT1A0372	2.5	2.5	5	4	3		3	3		3	20	1.5	1.5	3	3		1	1	4		4	14	17	39	22
16RT1A0378	2.5	2.5	5	4	4		4		4	4	22	0	0	4	5		3	3	5		5	17	20	59	40
16RT1A0379	2.5	2.5	5	4	4		4		4	4	22	1	1	4	5	1		1	5		5	17	20	39	20
16RT1A0385	2.5	2.5	5	4		4	4	4		4	22	2	2	4	5		1	1		5	5	19	21	49	29
16RT1A0388	2.5	2.5	5	4		4	4		5	5	23	0	0	4	5		2	2		5	5	16	20	49	30
16RT1A0390	2.5	2.5	5	5		5	5	4		4	24	2.5	2.5	4	5		3	3		5	5	22	23	49	26
16RT1A0391	2.5	2.5	5	4		4	4	4		4	22	1	1	4	5	1		1	5		5	17	20	59	40
16RT1A0392	2.5	2.5	5	4	4		4		4	4	22	2	2	4	5		2	2	5		5	20	21	49	28
16RT1A0394	2.5	2.5	5	4	4		4		4	4	22	1	1	4	5	1		1	5		5	17	20	59	40
16RT1A0396	2.5	2.5	5	4		4	4	3		3	21	2	2	5	5		1	1	4		4	19	20	59	39
16RT1A03A9	2.5	2.5	5	4		4	4	5		5	23	1	1	4	4		1	1		5	5	16	20	49	30

rage					1.44

-PO Matrix

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	Attainment
3	3	1	3	2					1	1	1	3	3	2	1.5
3	2	3	2	3					2	1	1	1	2	1	1.5
3	3	2	3							1	1	2	1	3	1.25
2	2	2	2	2						1	1	2	2	2	1.5
2.75	2.5	2	2.5	2.3333					1.5	1	1	2	2	2	1.4375

Final Attainment %
CO1 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
CO2 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
CO3 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)
CO4 = (DIRECT ATTAINMENT*0.8) + (INDIRECT ATTAINMENT*0.2)

urse PO Attainments

PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3
317708333	1.1979	0.9583	1.1979	1.1181	0	0	0	0	0.7188	0.47917	0.47917	0.9583	0.9583	0.9583
1.27	1.21	1.27	1.25	1.22	0	0	0	0	1.03	0.85	0.72	1.25	1.29	1.25
308166667	1.2	1.021	1.208	1.138	0	0	0	0	0.781	0.5533	0.5273	1.017	1.025	1.017

PO ATTAINMENTS
DIRECT ATTAINMENT (PO1)= (Average of PO1*Average of CO Direct Attainment)/3
Similar for PO2 TO PO12 & PSO1 TO PSO3
INDIRECT ATTAINMENT (PO1) = (Average of PO1*Average of CO Direct Attainment)/2
Similar for PO2-PO12 & PSO1 TO PSO3
FINAL ATTAINMENT = (DIR ATNM-PO1)*0.8 + (INDIR ATNM-PO1)*0.2

7 Individual Time Table

Sec.-A

Faculty Name	Mr.HAMED KHAN		Subject: CNC TECH
Days	9:30-12:00	LUNCH	2:00 – 4:30
MON			
TUE			
WED	CNC TECH		
THUR			
FRI			CNC TECH
SAT			

Sec.-B

Faculty Name	Mr.ABDUL SAMAD		Subject: CNC TECH
Days	9:30-12:00	LUNCH	2:00-4:30
MON			
TUE			
WED	CNC TECH		
THUR			
FRI			CNC TECH
SAT			

8 Class Time Table

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY DEPARTMENT OF MECHANICAL ENGINEERING

TIME TABLE Sec.-A

Academic year:	2020-2021	Year- Semester:	IV-I A
Course:	B. Tech	Room No.:	ONLINE

	9:30 to 12:00	12:00 to 2:00	2:00 to 4:30
MONDAY	PPE	LUNCH BREAK	AMT
TUESDAY	ICS		CAD/CAM
WEDNESDAY	CNC TECH		PPE
THURSDAY	CAD/CAM		ICS
FRIDAY	AMT		CNC TECH
Saturday	SEMINAR		MINI PROJECT

THEORY: **LABS:**

SUBJECT NAME	NAME OF THE FACULTY	LAB NAME	NAME OF THE FACULTY
POWER PLANT ENGG (PPE)	Mr.VINAY KULKARNI	CAD/CAM LAB	Mr.MANSOOR HASSAN(K) /Mr.KIRAN
CAD/CAM	Mrs.TASLEEM BANU	ICS LAB	Mrs. KAUSAR /Mr. YOUSF ALI
INSTRUMENTATION AND CONTROL SYSTEM	Mr.UMAIR ANSARI	SEMINAR	Mr. RAZA AHMED KHAN
CNC TECH	Mr.KIRAN KUMAR	MINI PROJECT	Dr. MUJAHED HUSSAINI
AMT	Mr. SHABIR AHMED		

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING & TECHNOLOGY DEPARTMENT OF MECHANICAL ENGINEERING

TIME TABLE Sec.-B

Academic year:	**2020-2021**	**Year-Semester:**	**IV-I B**	
Course:	**B. Tech**	**Room No.:**	**ONLINE**	
	9:30 to 12:00		**12:00 to 2:00**	**2:00 to 4:30**
MONDAY	PPE		LUNCH BREAK	AMT
TUESDAY	ICS			CAD/CAM
WEDNESDAY	**CNC TECH**			PPE
THURSDAY	CAD/CAM			ICS
FRIDAY	AMT			**CNC TECH**
Saturday	SEMINAR			MINI PROJECT

THEORY: **LABS:**

SUBJECT NAME	NAME OF THE FACULTY	LAB NAME	NAME OF THE FACULTY
POWER PLANT ENGG (PPE)	Mr. MUSHTAQ AHMED	CAD/CAM LAB	Mrs.MANSOOR HASSAN(H)/Mr.M.A MOYEED
CAD/CAM	Mr.ABDUL RAHMAN	ICS LAB	Mr. MUSHATAQ I /Mr. SANAGAMESH
INSTRUMENTATION AND CONTROL SYSTEM	Dr. VASANTH KUMAR	SEMINAR	Dr.KM MEHBOOB SHERIF
CNC TECH	Mr.MANSOOR HASSAN (H)	MINI PROJECT	Dr. ZAHIR HASAN
AMT	Mr.HAROON BAIG		

Co.

17. Assignment questions

Assignment Questions-1

1. State advantages and limitations of CNC machine tools.
2. How does the structure of NC/CNC machine tools differ from conventional machine tools?
3. Describe with sketch the working and construction of recirculating ball screw used in CNC machine tools.
4. Define Numerical Control. What are the different components of an N/ C system?
5. What are canned cycles? Discuss how a canned cycle is useful in writing a part program?
6. What is direct numerical control? How it is different from computerized Numerical Control (CNC).
7. Briefly explain CNC Machine elements with suitable diagram.
8. What is NC part programming? What is manual part programming? And how it is differ from part program?
9. What is machine structures? Differentiate between Guide ways, feed drives, and spindles.
10. What is quick-change tooling system and automatic head changers.

Assignment Questions-2

1. Define part programming. Differentiate between manual part programming and computer aided part programming.
2. Discus the basic structure of the part program with example?
3. Why the repetitive programming is used? Explain its various types.
4. How a closed loop control system is more advantageous as compared to an open-loop control system?
5. Explain the steps involved in preparing a part programme.
6. What is meant by interpolation? How is it implemented on an NC machine tool?
7. What are the essential elements of a PLC system?
8. What are common problems in? (i) Mechanical components of CNC (ii) Electrical components of CNC.
9. Explain the steps of automatic tool changing in an NC machining Centre.
10. What is difference between Micro Controllers, Embedded Controllers? Write applications and Programming of Micro Controllers.

18. University Question Papers of Previous Years

R16

Code No: 137BD

JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
B. Tech IV Year I Semester Examinations, December - 2019
CNC TECHNOLOGY
(Mechanical Engineering)

Time: 3 Hours **Max. Marks: 75**

Note: This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A. Part B consists of 5 Units. Answer any one full question from each unit. Each question carries 10 marks and may have a, b as sub questions.

PART – A

(25 Marks)

1.a) What are the advantages of CNC in contrast to NC? [2]
b) What are the features of N/C machine Tools? [3]
c) What is parametric programming? [2]
d) Describe modular fixturing. [3]
e) What are the advantages of numerical control? [2]
f) Write a short note on Automatic Tool path generation. [3]
g) What are the disadvantages of DNC? [2]
h) What are the features of adaptive control systems? [3]
i) What is a microcontroller? [2]
j) What are the applications of PLC's in CNC machines? [3]

PART – B

(50 Marks)

2. What are the design considerations of NC Machine Tools and How to improve machining accuracy? [10]

OR

3. What is the meaning of the following N.C. words used in word address format – J, G, X, Y, Z, F, S, T, M, EOB. [10]

4. Explain the terms 'Pre-set' and 'Qualified' in the context of CNC tooling. [10]

OR

5. What is the difference between "incremental and point to point" system? [10]

6. What is your opinion about future of numerical control? [10]

OR

7. Define NC-part programming. Why the computer aided programming is preferred for NC - Machine tools. [10]

Question Paper Code : 91[illegible]

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2011

Fifth Semester

Mechatronics Engineering

ME 3110080210024 — CNC TECHNOLOGY

(Regulation 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define NC Machine tool.
2. What do you mean by fixed zero and floating zero?
3. How is backlash error compensated in the CNC machine.
4. List the functions of timing belt in the CNC machine.
5. State the role of sensor in the CNC machine.
6. What do you mean by cutter radius compensation?
7. Define subroutine.
8. State the benefits of using CAM packages in the CNC machines.
9. How to improve the CNC machine life?
10. State the merits of using CNC machines.

PART B — (5 × 16 = 80 marks)

11. (a) Discuss the various classifications of CNC machines with necessary illustrations. (16)

Or

(b) (i) Describe the various elements of CNC machine. (8)

(ii) Discuss the CNC coordinate method with neat diagram. (8)

7E 7018

Roll No. ______________________ [Total No. of Pages : 2

7E 7018

B.Tech. VII Semester (Main) Examination, Dec. - 2015

Mechanical Engineering

7ME6.3A CNC Machines and Programming

ME&PI

Time : 3 Hours

Maximum Marks : 80
Min. Passing Marks : 24

Instructions to Candidates:

*Attempt any five questions, selecting one question from each unit. All questions carry **equal** marks. (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly).*

Unit - I

1. a) Define NC, CNC. Also explain their developments and improvements in their applications. **(8)**

   b) Compare NC machines with conventional machines and write down advantages of NC machines over conventional machines. **(8)**

OR

1. a) Define Automation. What are different types of Automation? Compare hard automation and soft automation. **(10)**

   b) Write down applications of Numerical control machines. **(6)**

Unit - II

2. a) Write down various design consideration of NC machines. **(6)**

   b) How many type of drive can be used in NC system ? Also write down about spindle and feed drive. **(10)**

OR

2. a) What do you meant by Architecture of NC system? Describe it briefly **(6)**

   b) Define sensors and their applications in Numerical control machines? Also write various types of sensors. **(10)**

Unit - III

3. a) "Use of canned cycle reduce the length of a manual part program". Justify this statement with suitable example. **(12)**

   b) What is the format of a block in manual part programming? **(4)**

OR

3. a) Write down the syntax for defining a geometry in computer- assisted part programming. Also name the four types of statements in a complete APT part program. **(10)**

   b) Define Automatic part program generation. **(6)**

Unit - IV

4. Write short notes on

   a) CAPP systems. **(8)**

   b) CMM **(8)**

19. Mid Wise Question Papers, Quiz Questions, Key Answers

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
New Malakpet, Hyderabad 500024
IV-I SEMESTER B.TECH MID-I EXAMINATION September 2020

BRANCH: Mechanical Engineering
SUBJECT: CNC Technology

Date: 16/09/2020
Time: 60 minutes

I. Answer any two of the following questions.
2X5=10

Q.No	Questions	Bloom's Level	CO maping
1.	a) What are the difference between NC and CNC machine? b) Classify CNC machines tools on the basis of : (i) Types of motion control (ii) According to programming Method.	L1, L2	CO1
2.	a) Distinguish point to point and continuous path CNC control. b) Classify NC systems, incremental and absolute, open and closed loop systems.?	L3, L2	CO1
3.	a) State various automated programmed tool languages. b) What is machine structures? Differentiate between Guide ways, feed drives, and spindles.	L1, L2	CO1, CO2
4.	a) What is NC part programming? b) What is interchangeable tooling system, preset and qualified tools, coolant fed tooling system.	L1, L1	CO2

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
IV B.Tech. I Sem., I Mid-Term Examinations, September-2020
CNC Technology
Objective Exam

Name: ______________________ **Hall Ticket No.** [| | | | | | | | | |]

Answer All Questions. All Questions Carry Equal Marks. **Time: 20 Mints. Marks: 10**

I. Choose the Correct alternative:

1) What is the purpose of using re-circulating ball screw nut mechanism in CNC **machine** [ ]
(A) To reduce the set up time (B) For higher surface finish
(C) To remove jerks in machine (D) To remove backlash

2) Which of the following statements are correct for CNC machine tool; [ ]

1. CNC control unit does not allow compensation for any changes in the dimensions of cutting tool.
2. CNC machineshave lower capital cost compared to conventional machines.
3. It is possible to obtain information on machine utilization which is useful to management in CNC machine tool.
4. CNC machine tool has greater flexibility.
5. CNC machine can diagnose program and can detect the machine defects even before the part is produced.

(A) 1,2&3 (B) 2,4&5 (C) 3,4&5 D) 2,3,4&5

3) Using Anti friction linear guideways in CNC machine tools, all of following benefits except[ ]
(A) Less heat generation (B) Traverse speed
(C) Moredamping capacity (D) Reduced stick slip

4) An ATC plays a significant role in reducing [ ]
(A) Tool change time (B) Idle time
(C) Machining time (D) Control time

5) In a CNC machine, which kind of switches examine or detect the presence of an item or object without making contact with them; [ ]
(A) Proximity Switches (B)Limit Switches
(C) Photo-electric Switches (D) Mechanical Switches

6) G-codes are used as _____ functions. [ ]
a) Miscellaneous b) Preparatory
c) Machine d) Work piece

Cont.....2

CNC Technology
Mid-I Exam Keys

I. Choose the correct alternative:

1. d
2. c
3. c
4. a
5. a
6. b
7. c
8. b
9. b
10. a

II. Fill in the blanks:

11. Depth of cut
12. Welding
13. In parallel
14. Reaming
15. Direct current and alternating current
16. APT (Automatically Programmed Tool)
17. Continuous path positioning
18. Cutting Speed.
19. Canned.
20. In parallel.

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY

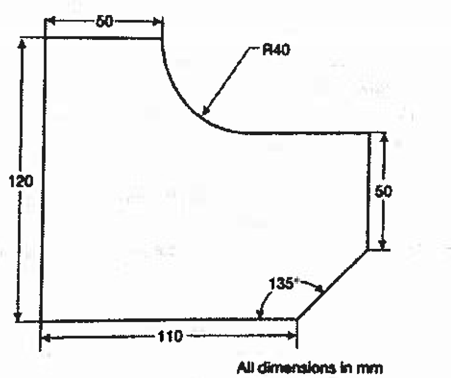
New Malakpet, Hyderabad 500024

IV-I SEMESTER B.TECH MID-II EXAMINATION November 2020

BRANCH: Mechanical Engineering **Date: 22/11/2020**

SUBJECT: CNC Technology **Time: 60 minutes**

I. Answer any two of the following questions. **2X5=10**

Q.No	Questions	Bloom's Level & CO maping
1.	b) What is meant by interpolation? How is it implemented on an NC machine tool? a) Describe the role of Automatic Tool Changers (ATC) in machining centers with schematic diagrams.	L1, L2, CO3
2.	a) Prepare a complete APT part program for the following component shown in figure using an end mill cutter of 20mm diameter. Clearly show the axes system chosen with a sketch and the direction of the cutter for the motion statements.  *Fig. 16.43 Part drawing for Example 16.11* b) How a closed loop control system is more advantageous as compared to an open-loop control system?	L5, L1, CO2, CO3
3.	a) Distinguish between Model and no model code. Explain with example. Differentiate between absolute programming and incremental programming. b) Explain different types of DNC systems, advantages and disadvantages of DNC system.	L4, L2, CO4
4.	a) What is a PLC? Explain major components of a PLC. List various applications of PLC. b) What is difference between Micro Controllers, Embedded Controllers? Write applications and Programming of Micro Controllers	L1, L1, CO4

NAWAB SHAH ALAM KHAN COLLEGE OF ENGINEERING AND TECHNOLOGY
IV B.Tech. I Sem., II Mid-Term Examinations, November-2020
CNC Technology
Objective Exam

Name: ______________________ **Hall Ticket No.** [| | | | | | | | | |]

Answer All Questions. All Questions Carry Equal Marks. **Time: 20 Mints. Marks: 10**

II. Choose the Correct alternative:

1) Several machine tools can be controlled by a central computer in [ ]

a) NC (Numerical Control) machine tool

b) CNC (Computer Numerical Control) machine tool

c) DNC (Direct Numerical Control) machine tool

d) CCNC (Central-Computer Numerical Control) machine tool

2) **In NC (Numerical Control) machine tool, the position feedback package is connected between** [ ]

a) control unit and programmer

b) programmer and machine tool

c) control unit and machine tool

d) programmer and process planning

3) **In CNC machine tool, the part program entered into the computer memory** [ ]

a. can be used only once

b. can be used again and again

c. can be used again but it has to be modified every time

d. cannot say

4) **Which of the following statements are correct for CNC machine tool?** [ ]

1. CNC control unit does not allow compensation for any changes in the dimensions of cutting tool
2. CNC machine tool are suitable for long run applications
3. It is possible to obtain information on machine utilization which is useful to management in CNC machine tool
4. CNC machine tool has greater flexibility
5. CNC machine can diagnose program and can detect the machine defects even before the part is produced

a. (1), (2) and (3)

b. (2), (4) and (5)

c. (3), (4) and (5)

d. (2), (3), (4) and (5)

Cont.....2

CNC Technology
Mid-II Exam Keys

III. Choose the correct alternative:

1. C
2. C
3. B
4. C
5. B
6. B
7. D
8. B
9. C
10. C

IV. Fill in the blanks:

11. In parallel
12. Reaming
13. Helicoidal
14. Machine zero point
15. Linear motor
16. Moredamping capacity
17. Tool position or speed to Machine Control.
18. Spindle ON clockwise
19. Interrupt.
20. Curved

22.1 Student List with Advanced Learners on the Basis of CNC TECH MID-1 Exam

S. No.	Roll No.	Student Name	Mid-1 Total (25M)
1	17RT1A0301	ABDUL MANNAN BAIG	23
2	17RT1A0307	ARAFAT	22
3	17RT1A0308	BILAL MOHAMMED ATEEQ	24
4	17RT1A0311	HAMED BIN TAHER HARHARA	24
5	17RT1A0312	ISMAIL PASHA	22
6	17RT1A0319	MIRZA AFROZ BAIG	22
7	17RT1A0320	MIRZA AMAIR BAIG	22
8	17RT1A0321	MIRZA FARHAN BAIG	23
9	17RT1A0326	MOHAMMED ABDUL HADI	21
10	17RT1A0327	MOHAMMED ABDUL JALEEL	22
11	17RT1A0328	MOHAMMED ABDUL RAHMAN ALEEM	22
12	17RT1A0329	MOHAMMED ADNAN HUSSAIN	22
13	17RT1A0330	MOHAMMED ABDUL WAJID	23
14	17RT1A0332	MOHAMMED ABDULLAH GHORI	22
15	17RT1A0333	MOHAMMED ABIDULLAH ANSARI	20
16	17RT1A0334	MOHAMMED ABRAR HASSAN	21
17	17RT1A0336	MOHAMMED ASAD AHMED	20
18	17RT1A0338	MOHAMMED AZIZUDDIN	23
19	17RT1A0341	MOHAMMED HYDER AHMED	22
20	17RT1A0342	MOHAMMED ILYAAS AKBAR	21
21	17RT1A0343	MOHAMMED IMRAN	20
22	17RT1A0344	MOHAMMED INZEMAMUDDIN	20
23	17RT1A0346	MOHAMMED JUNAID	22
24	17RT1A0348	MOHAMMED KHADER JILANI	23
25	17RT1A0351	MOHAMMED MUHEEB UDDIN ASLAM	21
26	17RT1A0356	MOHAMMED SHAHBAZ HUSSAIN	20
27	17RT1A0357	MOHAMMED SHAHER YAR KHAN	21
28	17RT1A0360	MOHAMMED TAJ	24
29	17RT1A0361	MOHAMMED VASIUDDIN	20
30	17RT1A0362	MOHAMMED YASSER	21
31	17RT1A0366	MOHD ABDUL QAVI	21

22.2 Student List with Slow Learners on the Basis of CNC TECH MID-1Exam

S. No.	Roll No.	Student Name	Mid-1 Total (25M)
1	17RT1A0331	MOHAMMED ABDUL WASY	18
2	17RT1A0378	MOHAMMED KHAJA	18
3	17RT1A0381	MOHD NADEEM	18
4	17RT1A0394	SHAIK ABDUL WASI	16
5	17RT1A03A6	SYED ESA GIBRAN	19
6	17RT1A03A7	SYED FARDEEN ALI	19
7	17RT5A0306	MD SUMER MOSITH	19
8	18D95A0311	SYED MAAZUDDIN	18
9	18RT5A0302	AHMED ABDUL HAQUE	18
10	18RT5A0303	CHEGONDI SIVALINGA RAJU	15
11	18RT5A0306	KAMA NAVEEN	18
12	18RT5A0310	M A MUNAWAR	19

23. CO & PO Attainment