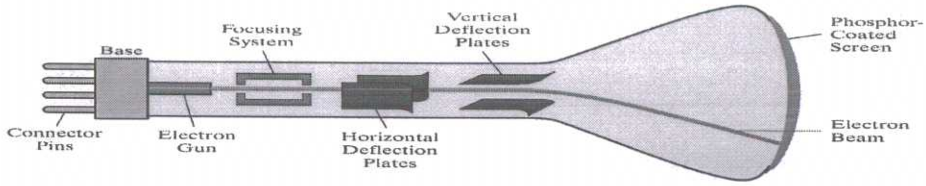
Scoring Indicators

Code : 6024

Version: B

Qn. No.	Scoring Indicators	Split score	Total Score
I (1)	CAD-Computer Aided Design CAM- Computer Aided Manufacturing	2	2
I (2)	Input Devices : Mouse, Keyboard , Digitizer, Image Scanner etc Output Devices: CRT, raster scan , direct view storage tube, LCD, plasma panel etc	1 1	2
I (3)	Computer-aided manufacturing (CAM) is an application technology that uses computer software and machinery to facilitate and automate manufacturing processes. CAM is the successor of computer-aided engineering (CAE) and is often used in tandem with computer-aided design (CAD)	2	2
I (4)	• Storage of more than one part program • Use of diskettes • Program editing at the machine tool site • Fixed cycles and programming subroutine • Interpolation • Positioning features for setup • Cutter length compensation • Diagnostics • Communication Interface (Any Four)	1 1 1 1	2
I (5)	G70 - Fixed cycle, multiple repetitive cycle, for finishing (including contours) G71 Fixed cycle, multiple repetitive cycle, for roughing (Z-axis emphasis)	1 1	2
II (1)	▪ The cathode ray tube (CRT) is a vacuum tube containing an electron gun (a source of electrons) and a fluorescent screen, with internal or external means to accelerate and deflect the electron beam, used to create images in the form of light emitted from the fluorescent screen. The image may represent electrical waveforms (oscilloscope), pictures (television, computer monitor), radar targets and others. ▪ A CRT monitor contains millions of tiny red, green, and blue phosphor dots that glow when struck by an electron beam that travels across the screen to create a visible image. In a CRT monitor tube, the cathode is a heated filament. The heated filament is in a vacuum created inside a glass tube. The electrons are negative and the screen gives a positive charge so the screen glows	3	



3 6

II(2)

Workstation based System : Is a standalone computer system that is dedicated to one user and capable of executing graphics software and other programs requiring high-speed computational power. The graphics display is a high-resolution monitor with a large screen. As shown in our figure, engineering workstations are often networked to permit exchange of data files and programs between users and to share plotters and data storage devices. CAPP is the application of computer to assist the human process planer in the process planning function 3

PC Based Workstation: Is a PC with a high-performance CPU and medium to high resolution graphics display screen. The computer is equipped with a large random access memory (RAM), math coprocessor, and large capacity hard disk for storage of the large applications software packages used for CAD. PC-based CAD systems can be networked 10 share file" output devices, and for other purposes. Starting around 1996, CAD software developers began offering products that utilize the excellent graphics environment of Microsoft Windows NT, thus enhancing the popularity and familiarity of PC-based CAD. 3 6

II(3)

1. Reduced process planning and production lead-times.
2. Faster response to engineering changes in the product 1
3. Greater process plan accuracy and consistency 1
4. Inclusion of up-to-date information in a central database
5. Improved cost estimating procedures and fewer calculation errors 1 6
6. More complete and detailed process plans 1
7. Improved production scheduling and capacity utilization 1
8. Improved ability to introduce new manufacturing technology and rapidly update process plans to utilize the improved technology **(Any SIX)** 1

II(4)

Concurrent engineering is a systematic approach to the integrated, concurrent design of products and their related processes, including manufacture and support. This approach is intended to cause the developers from the outset, to consider all elements of the product life cycle from conception to disposal, including quality, cost, schedule, and user requirements. 2

- Increasing product variety and technical complexity that prolong the product development process and make it more difficult to predict the impact of design decisions on the functionality and performance of the final product. 1
- Increasing global competitive pressure that results from the emerging concept of reengineering. 1 6
- The need for rapid response to fast-changing consumer demand. The need for shorter product life cycle. 1
- Large organizations with several departments working on developing numerous products at the same time. 1

New and innovative technologies emerging at a very high rate, thus causing the new product to be technological obsolete within a short period

II(5)

Adaptive control is the control method used by a controller which must adapt to a controlled system with parameters which vary, or are initially uncertain. For example, as an aircraft flies, its mass will slowly decrease as a result of fuel consumption; a control law is needed that adapts itself to such changing conditions. Adaptive control is different from robust control in that it does not need *a priori* information about the bounds on these uncertain or time-varying parameters; robust control guarantees that if the changes are within given bounds the control law need not be changed, while adaptive control is concerned with control law changing itself 3 6

In general one should distinguish between:

1. Feedforward adaptive control
2. Feedback adaptive control

as well as between 3

1. Direct methods and
2. Indirect methods
3. Hybrid methods

Direct methods are ones wherein the estimated parameters are those directly used in the adaptive controller. In contrast, indirect methods are those in which the estimated parameters are used to calculate required controller parameters.[1] Hybrid methods rely on both estimation of parameters and direct modification of the control law.

II(6)

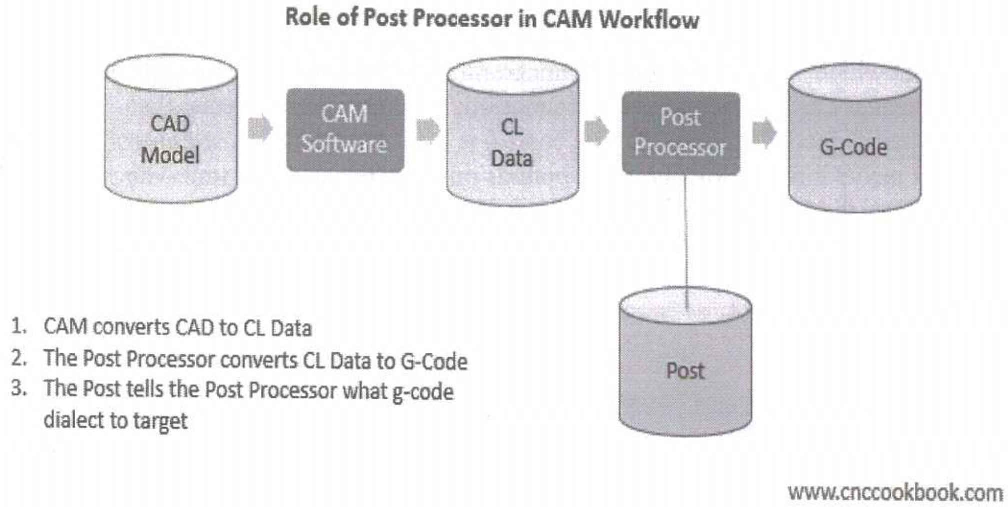
1. Precision Components 1
2. Reliable Endurance
3. High Production and Scalability 1
4. More Capability
5. Less Labor 1 6
6. Uniform Product
7. Lower Costs 1
8. Fewer Headaches
9. Better Safety 1
10. Low Maintenance (Brief Explanation of Six points) 1

II(7)

Most CAM systems generate one or more types of neutral language files containing instructions for a CNC machine. These are either in a binary format called CLDATA or some ASCII readable format tailored after the APT language. APT is an acronym for “Automatically Programmed Tools,” software that accepts symbolic geometry and manufacturing instructions, and generates CLDATA describing the manufacturing operation in absolute terms. Some CAM systems provide a large degree of flexibility, allowing just about anything to be included in the neutral file, others are quite strict about what can and cannot be included

At the other end of the equation sits the NC machine. It requires input customized for the controller being used and arguably to a lesser extent, the operator running the machine. Most important, the NC machine must be driven in a manner that satisfies shop floor criteria, which are primarily based on safety, efficiency and tradition. 3

Between these two lies the post-processor. The post-processor is software responsible for translating neutral instructions from the CAM system into the specific instructions required by the NC machine (Figure 1). This software responds to the unique requirements and limitations of the CAM system, NC machine and manufacturing environment. Therefore, post-processing is an important part of factory automation, as is anything that lies on the critical path between the design engineer and the shipping department



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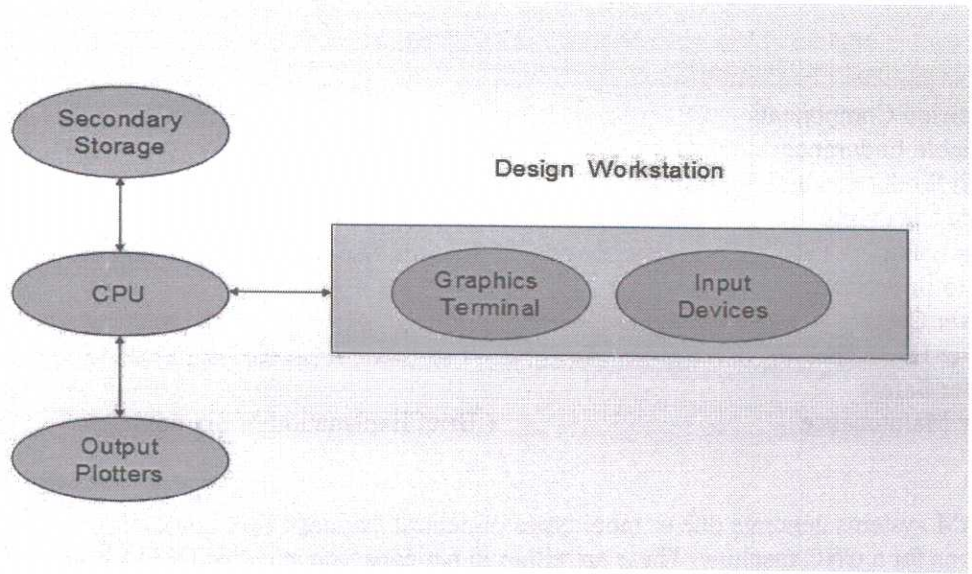
III(a)



4 8

- The CAD workstation is the system interface with the outside world
- It represent a significant factor in determining how convenient and efficient it is for a designer to use the cad system
- Major components are – graphic terminals and operator input devices
- A general computer system can not be considered as workstation because it lacks graphics terminals and special input devices like electronic tablet and pen.

4

III(b)

Liquid crystal display screen **works** on the principle of blocking light rather than emitting light. **LCD's**requires backlight as they do not emits light by them. We always use devices which are made up of **LCD's**displays which are replacing the use of cathode ray tube. Liquid crystal display is composed of several layers which include two polarized panel filters and electrodes. LCD technology is used for displaying the image in notebook or some other electronic devices like mini computers. Light is projected from a lens on a layer of liquid crystal. This combination of colored light with the grayscale image of the crystal (formed as electric current flows through the crystal) forms the colored image. This image is then displayed on the screen

4

Working

The principle behind the LCD's is that when an electrical current is applied to the liquid crystal molecule, the molecule tends to untwist. This causes the angle of light which is passing through the molecule of the polarized glass and also cause a change in the angle of the top polarizing filter. As a result a little light is allowed to pass the polarized glass through a particular area of the LCD. Thus that particular area will become dark compared to other. The LCD works on the principle of blocking light. While constructing the LCD's, a reflected mirror is arranged at the back. An electrode plane is made of indium-tin oxide which is kept on top and a polarized glass with a polarizing film is also added on the bottom of the device. The complete region of the LCD has to be enclosed by a common electrode and above it should be the liquid crystal matter.

Marks: 3 | 7

IV(a)

Basic Geometric Modelling Techniques Basic Geometric Modelling Techniques

- 2-D Projection (Drawings)
- Wireframe Modelling
- Surface Modelling
    - -Analytical Surface
    - - Free-form, Curved, & Sculptured Surface
- Solid Modelling Solid Modelling
    - - Constructive Solid Geometry (CSG)
    - - Boundary Representation (B-Rep)

Marks: 3 + 1

• 2-D Projection (Drawings)

A 2D geometric model is a geometric model of an object as a two-dimensional figure, usually on the Euclidean or Cartesian plane. Even though all material objects are three-dimensional, a 2D geometric model is often adequate for certain flat objects, such as paper cut-outs and machine parts made of sheet metal

Marks: 1 | 8

• Wireframe Modelling

Model consists entirely of points, lines, arcs and circles, conics, and curves. The word "wireframe" is related to the fact that one may imagine a wire that is bent to follow the object edges to generate a model. In 3D wireframe model, an object is not recorded as a solid. Instead the vertices that define the boundary of the object, or the intersections of the edges of the object boundary are recorded as a collection of points and their connectivity.

Marks: 1

• Surface Modelling

A surface model A surface model is a set of faces a set of faces. A surface model consists of wireframe entities that form the basis to create surface entities the basis to create surface entities. In general, a wireframe model can be extracted from a surface model surface model by deleting or blanking all surface entities deleting or blanking all surface entities .Shape design and representation of complex objects such as car, shipp g , and airplane bodies as well as castings . Used to be separated, shape model are now incorporated into solid models

Marks: 1

IV(b)

• Solid Modelling Solid Modelling

The solid modelling technique is based upon the "half-space" concept. The boundary of the model separates the interior and exterior of the modelled object. The object is defined by the volume space contained within the defined boundary of the object. In general speaking, a closed boundary is needed to define a solid object. Informationally complete, valid, and unambiguous represent ti a on (Spatial addressability) – points in space to be classified relative to the object, if it is inside outside or on the object inside, outside, or on the object . Store both geometric and topological information; can verify whether two objects occupy the same space. Improves the quality of design improves visualization and has improves the quality of design, improves visualization, and has potential for functional automation and integration

Full Form	Two-Dimensional	Three-Dimensional
Definition	Represents an object with just two dimensions, i.e. length, and height.	Represents an object with three dimensions: Length, width, and height
Representation	Flat	Life-like
Aspects	Length, and height, no depth (width).	Length, width, and height
Mathematics	The x-axis and y-axis.	The x-axis, y-axis and the z-axis.
Geometry	Rectangle, square, triangle, polygon, etc.	Cylinder, sphere, cube, pyramid, prism, etc.

7 7

V(a)

Traditional engineering, also known as sequential engineering, is the process of marketing, engineering design, manufacturing, testing and production where each stage of the development process is carried out separately, and the next stage cannot start until the previous stage is finished. Therefore, the information flow is only in one direction, and it is not until the end of the chain that errors, changes and corrections can be relayed to the start of the sequence, causing estimated costs to be under predicted.

his can cause many problems; such as time consumption due to many modifications being made as each stage does not take into account the next. This method is hardly used today[1], as the concept of concurrent engineering is more efficient. 4

Sequential engineering stages

1. Research
2. Design
3. Manufacture
4. Quality Control
5. Distribution
6. Sales

Brief explanation

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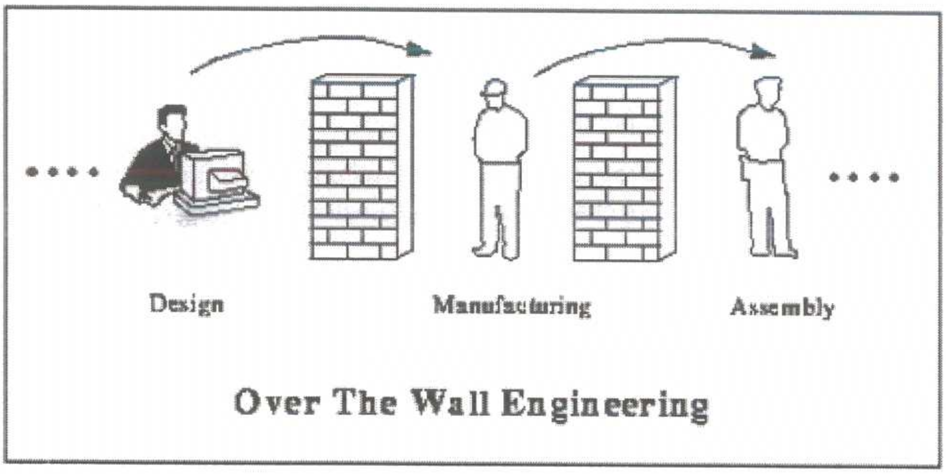

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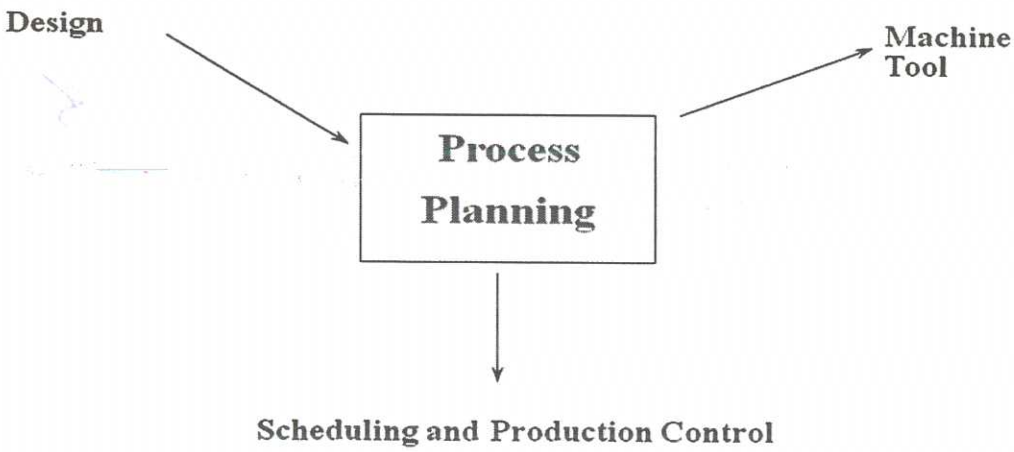
Figure.1.8.Over the Wall Engineering (Sequential Engineering)

PROCESS PLANNING

V(b)



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REQUIREMENTS IN MANUAL PROCESS PLANNING

- Ability to interpret an engineering drawing.
- Familiar with manufacturing processes and practice.
- Familiar with tooling and fixtures.
- Know what resources are available in the shop.
- Know how to use reference books, such as machinability data handbook.
- Able to do computations on machining time and cost.
- Familiar with the raw materials.
- Know the relative costs of processes, tooling, and raw materials.

PROCESS PLANNING STEPS

- Study the overall shape of the part. Use this information to classify the part and determine the type of workstation needed. 4 7
- Thoroughly study the drawing. Try to identify every manufacturing features and notes.
- Identify datum surfaces. Use information on datum surfaces to determine the setups.
- Select machines for each setup.
- For each setup determine the rough sequence of operations necessary to create all the features.
- Sequence the operations determined in the previous step.
- Select tools for each operation. Try to use the same tool for several operations if it is possible. Keep in mind the trade off on tool change time and estimated machining time.
- Select or design fixtures for each setup.
- Evaluate the plan generate thus far and make necessary modifications.
- Select cutting parameters for each operation.
- Prepare the final process plan document.

VI(a) 11 Principles and Guidelines in Design for Manufacturing and Assembly 11 points

1. Minimize number of components
2. Use standard commercially available components
3. Use common parts across product lines
4. Design for ease of part fabrication 8 8
5. Design parts with tolerances that are within process capability
6. Design the product to be foolproof during assembly
7. Minimize use of flexible components
8. Design for ease of assembly
9. Use modular design
10. Shape parts and products for ease of packaging
11. Eliminate or reduce adjustment required

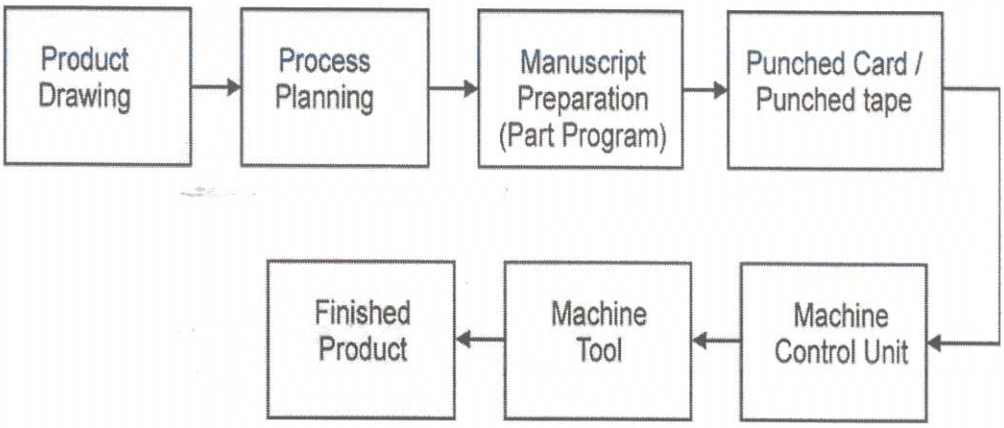
VI(b)

3D printing refers to processes in which material is joined or solidified under computer control to create a three-dimensional object, with material being added together (such as liquid molecules or powder grains being fused together). 3D printing is used in both rapid prototyping and additive manufacturing (AM). Objects can be of almost any shape or geometry and typically are produced using digital model data from a 3D model or another electronic data source such as an Additive Manufacturing 3

The term "3D printing" originally referred to a process that deposits a binder materialonto a powder bed with inkjet printer heads layer by layer. More recently, the term is being used in popular vernacular to encompass a wider variety of additive manufacturing techniques. United States and global technical standards use the official term additive manufacturing for this broader sense, since the final goal of additive manufacturing is to achieve mass-production, which greatly differs from 3D printing for Rapid prototyping. 2 7

3D printable models may be created with a computer-aided design(CAD) package, via a 3D scanner, or by a plain digital camera and photogrammetry software. 3D printed models created with CAD result in reduced errors and can be corrected before printing, allowing verification in the design of the object before it is printed.[22] The manual modeling process of preparing geometric data for 3D computer graphics is similar to plastic arts such as sculpting. 3D scanning is a process of collecting digital data on the shape and appearance of a real object, creating a digital model based on it. 2

VII(a)



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Lay-out of a NC System

In performing all the above operations, the NC machine may have the following elements:

1. Software
2. Machine Control Unit
3. Driving devices
4. Manual control unit
5. Machine tool

1. Software

A series of instructions are required to control the actions of a NC machine. These instructions are prepared based on the profile and the material of the part being manufactured. These instructions and their storage media can be called as software. 4

2. Machine Control Unit (MCU)

Machine Control Unit consists of electronic circuits (hardware) that are useful in reading and interpreting the instructions (NC program) fed by means of input media and convert them into mechanical actions of the machine tool.

Generally, the MCU may be of three types

- Inbuilt type
- Swing around type
- Stand alone type

3. Driving Devices

Driving devices consist of different types of motors and gear trains. They convert the instructions form the MCU into accurate mechanical displacements of the machine tool slides. The motors may be electrical, hydraulic or pneumatic.

Electrical motors are mainly used as prime movers because of their speed and torque characteristics. A.C. induction motors are cheap and easy to maintain. For easy and effective speed changes, D.C. motors are also used. 8

4. Manual Control Unit

Manual control unit consists of dials and switches to be operated by the operator. It may also have a display unit to provide useful informations to the operator. In some machines, the manual control unit may be a part of the MCU (machine control unit)

The operator use the manual contrl unit to

1. switch on and off the machine
2. load and unload the workpieces and
3. change the tools in certain types of machines

5. Machine Tool

It is the element of the NC machine which actually performs the useful work of converting the raw material to finished components. It is designed to perform various machining operations. It consists of a machine table, spindles, cutting tools, work holding devices such as jigs and fixtures, coolant systems, swarf removal systems and other auxiliary equipments.

VII(b)

Machine Tool Control involves the conversion of part program instruction into machine tool motion through computer interface and servo system. The capability to conveniently incorporate a variety of control futures in to the software controller unit is the main advantage of CNC. Some of the control functions, such as circular interpolation can be accomplished more efficiently with hard wired circuit than with the computer. Therefore there are two alternative controller designs in CNC 3

1. Hybrid CNC
2. Straight CNC

Hybrid CNC

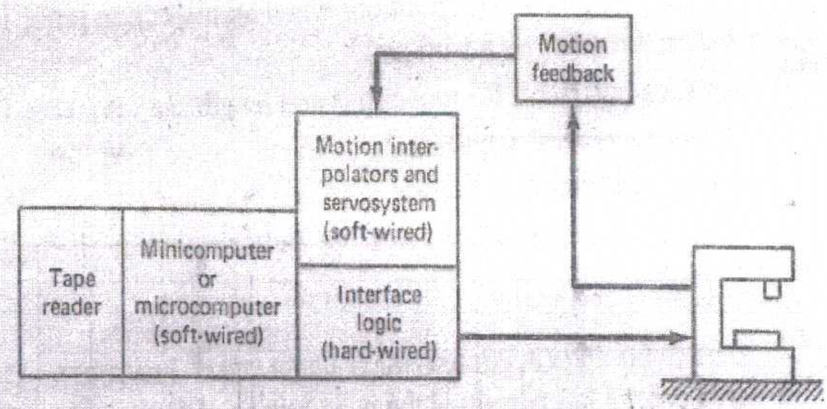

FIGURE 9.2 Hybrid CNC.

Straight CNC

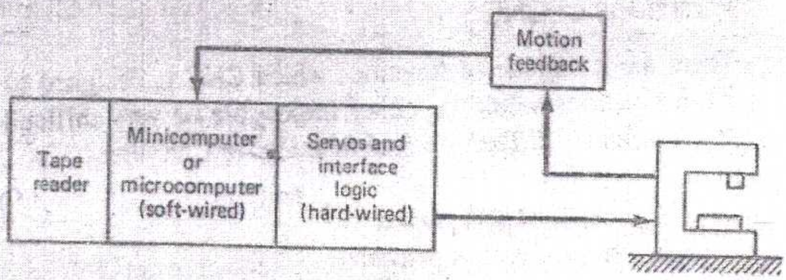

FIGURE 9.3 Straight CNC.

Functions of CNC

1. **Machine tool control**

- Hybrid CNC –Hard-wired logic circuits for functions like feed rate generation , circular interpolation etc. in addition to computer
  Mass production of circuits and less expensive computer
- Straight CNC – Computer to perform all NC functions

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VIII(a)

S.no	NC Machine	CNC Machine
1.	Here NC stands for Numerical Control	CNC stands for Computer Numerical Control.
3.	In NC machine the programs are fed into the punch cards.	In CNC machine the programs are fed directly into the computer by a small key board similar to our traditional keyboard.
4.	Modification in the program is difficult.	Modification in the program is very easy.
5.	High skilled operator is required.	Less skilled operator is required.
6.	Cost of the machine is less.	Cost of the CNC machine is high.
7.	Maintenance cost is less	Maintenance cost is high.
8.	The programs in the NC machine cannot be stored.	In CNC machines, the programs can be stored in the computer and can be used again and again.

VIII(b) Commonly performed with a **lathe**, **turning** reduces the diameter of a workpiece, typically to a specified dimension, and produces a smooth part finish. Sophisticated **turning centers** can also perform a variety of milling and drilling operations

Types of Turning Centre

1. CNC chucking center

   Holds part in some form of jaw chuck

   Some have dual spindles (work both ends)

2. CNC universal turning center

   Can use continuous bar feed system to machine and cut off parts from bar

   Some have dual tool turrets

3. Combination turning/milling center

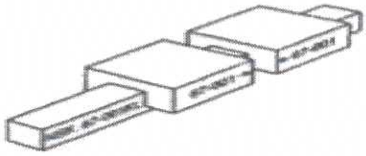
   Uses combination of turning tools

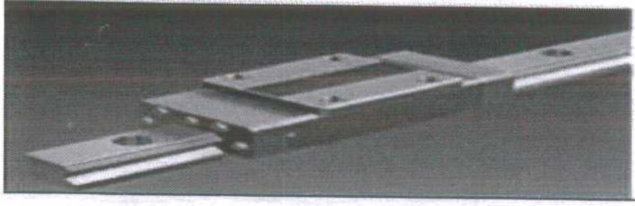
Brief Explanation of each

X(a)

SLIDE WAYS

- Hydrostatic slide ways
- Anti friction slide ways
- Wear resistant slide ways





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Hydrostatic slide ways

Hydrostatic slide ~> Oil pumped~>Cavities or Pockets~>Carriage on slides contact with Slide way with continous supply of thin film of fluid.

The hydrostatic slide way provides almost a frictionless condition for the movement of the slide. 4

For efficient operation it is very important that the fluid and slide ways are kept clean.

Also the hydrostatic slide ways need a very large surface area to provide adequate support.

Explanation with Diagram

IX(b)

The programmer must determine the position of the tool relative to the origin (zero point) of the coordinate system. NC machines have either of two methods for specifying the zero point. This can be done in two ways

- Fixed Zero 3
- Floating Zero

FIXED ZERO

In this case the origin is always located at the same position is for the machine table. Usually that position is the southwest corner of the table and all the tool locations will be defined by positive x and y coordinates. 7

FLOATING POINT ZERO

The second and more common feature on modern NC machines allows the machine operator to set the zero point at any position on the machinetable. This feature is called floating point zero. The part programmer is the one who decides where the zero point should be located. The decision is based on part programming convienience. For example the workpart may be symmetrical and the zero point should be established at the center of symmetry. 4

X(a)	Multiple Repetitive Cycle _ this cycle repeats till the required amount of material is removed Type of Multiple Repetitive Cycle 1. Stock Removal in Longitudinal (G71) 2. Contour Parallel Turning (G73) 3. Finished Cycle (G70) 4. Thread Cutting Cycle (G76) Brief explanation of Each cycle	2 2 2 2	8
X(b)	Compensation Function _ This functions are used for compensating the geometry of the tool Type of Compensation Functions 1. Tool Nose Compensation (G40-G42) 2. Changing tool offset amount (G10) Brief explanation of each cycle	2 3 2	7