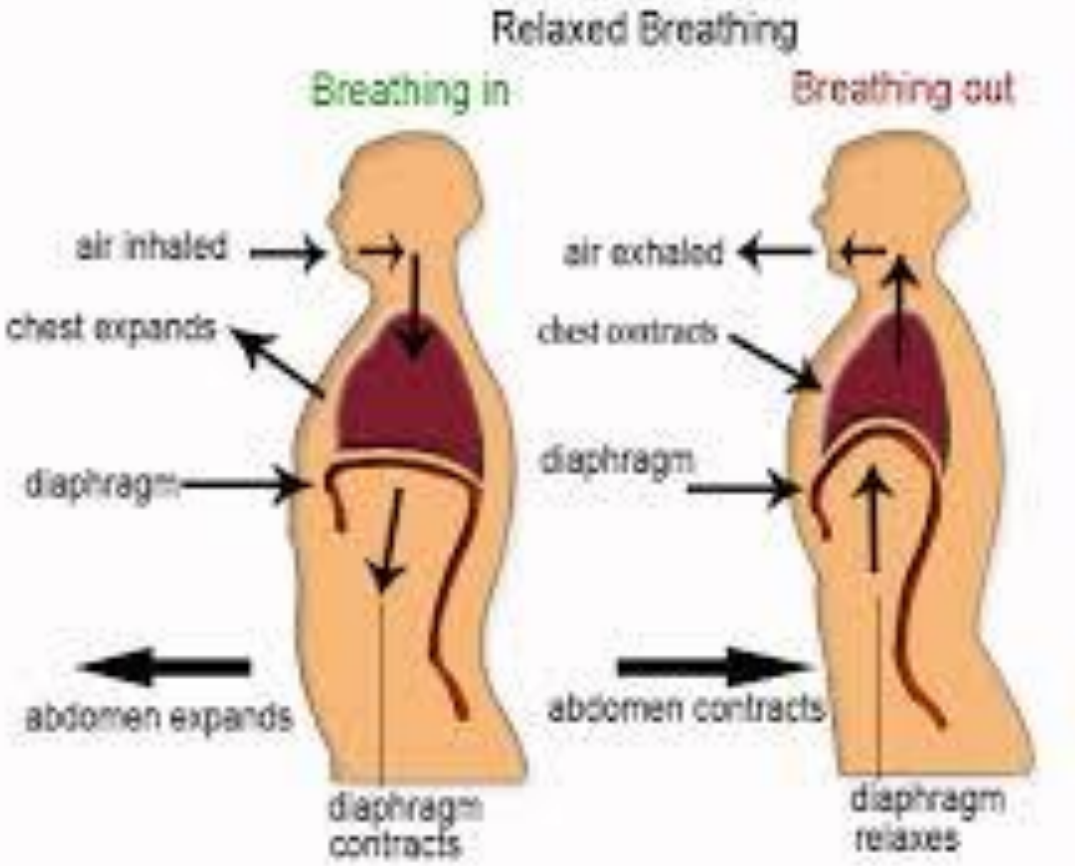

EGSPEC WELCOMES YOU

Computer Aided Manufacturing

Dr.S.RAMABALAN,
PRINCIPAL,
E.G.S. PILLAY ENGINEERING COLLEGE,
NAGAPATTINAM.

Relaxed Breathing

Belly breathing



Unit I

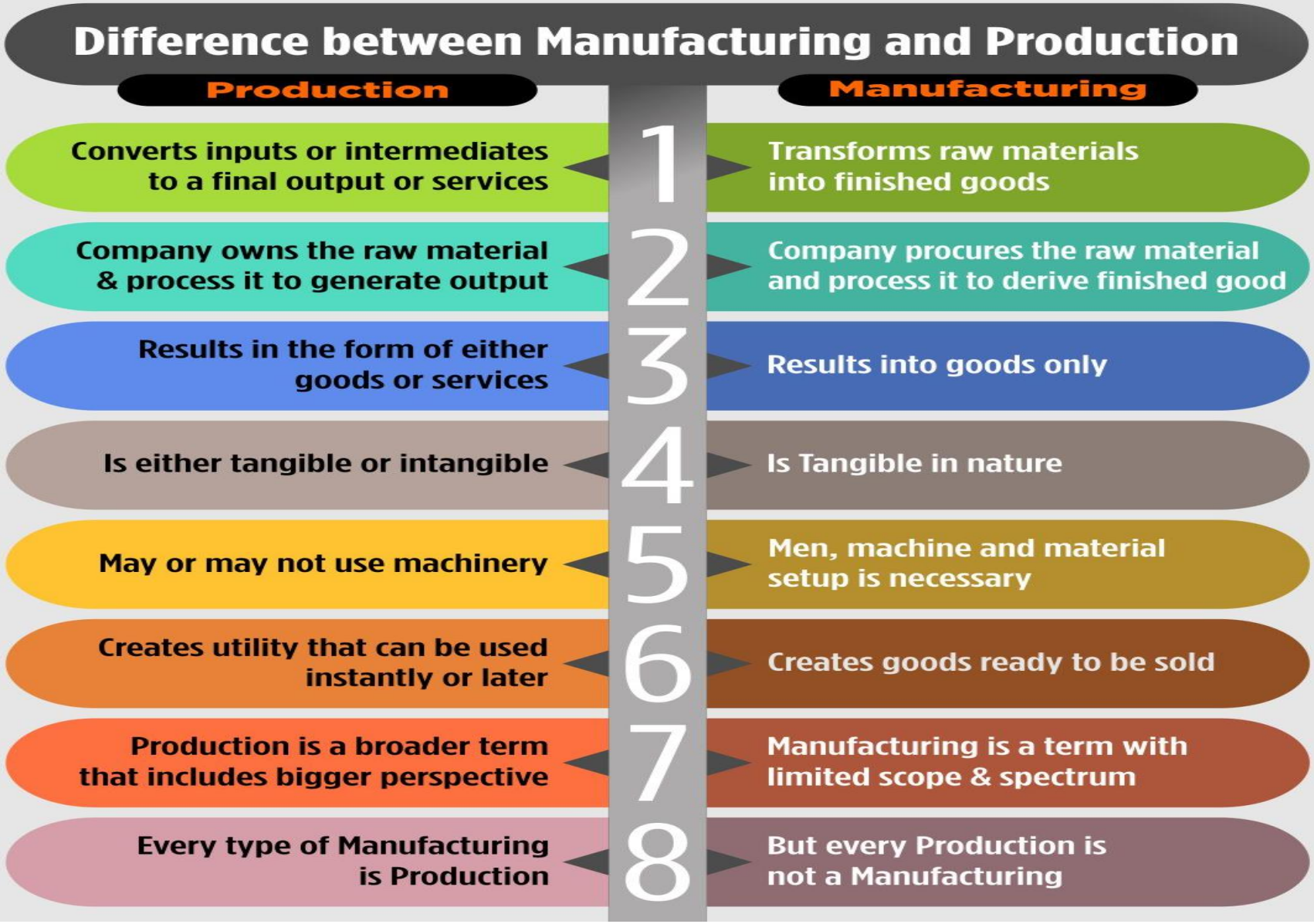
CONSTRUCTION OF CNC AND MOTION CONTROL

Evolution of CNC Technology - CNC machine -Concept, classification, features and applications -Constructional features and applications - Linear motion and Recirculating ball bearings - CNC controller and Interpolator - Maintenance and retrofitting

PRE-REQUISITE KNOWLEDGE

- Manufacturing Vs production
- Production Vs productivity
- Accuracy Vs precision
- Coordinate system and its types

2 minutes


Difference between Manufacturing and Production
Production
Manufacturing
1
Converts inputs or intermediates to a final output or services
Transforms raw materials into finished goods
2
Company owns the raw material & process it to generate output
Company procures the raw material and process it to derive finished good
3
Results in the form of either goods or services
Results into goods only
4
Is either tangible or intangible
Is Tangible in nature
5
May or may not use machinery
Men, machine and material setup is necessary
6
Creates utility that can be used instantly or later
Creates goods ready to be sold
7
Production is a broader term that includes bigger perspective
Manufacturing is a term with limited scope & spectrum
8
Every type of Manufacturing is Production
But every Production is not a Manufacturing

BASIS FOR COMPARISON	PRODUCTION	PRODUCTIVITY
Meaning	Production is a function of an organization which is associated with the conversion of range of inputs into desired output.	Productivity is a measure of how efficiently resources are combined and utilized in the firm, for achieving the desired outcome.
What is it?	Process	Measure
Represents	Numbers of units actually produced.	Ratio of output to input
Expression	Absolute terms	Relative terms
Determines	Value of output	Efficiency of factors of production

Mnemonic to Remember the Difference

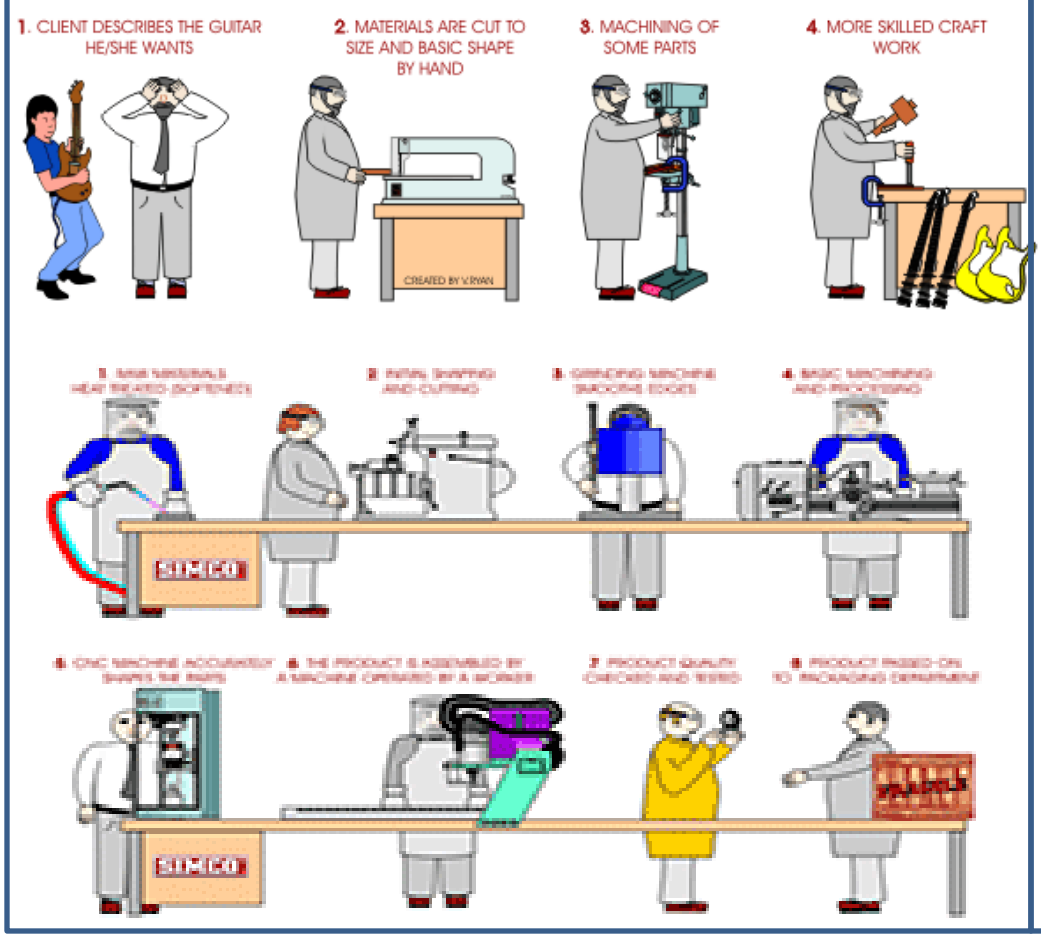
An easy way to remember the difference between accuracy and precision is:

A**C**curate is **C**orrect (or **C**lose to real value)

P**R**ecise is **R**epeating (or **R**epeatable)

EVOCATION

CONVENTIONAL



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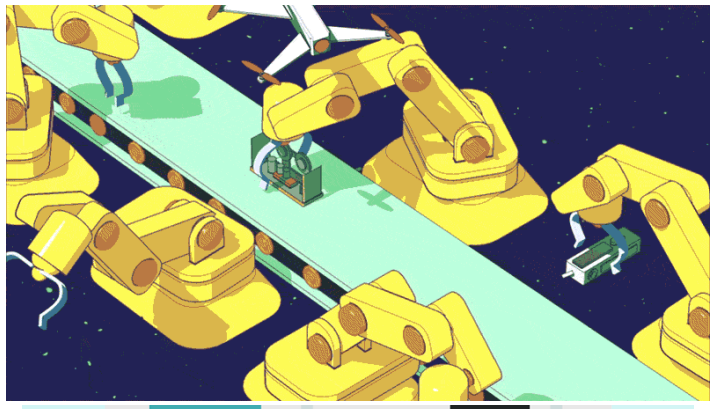
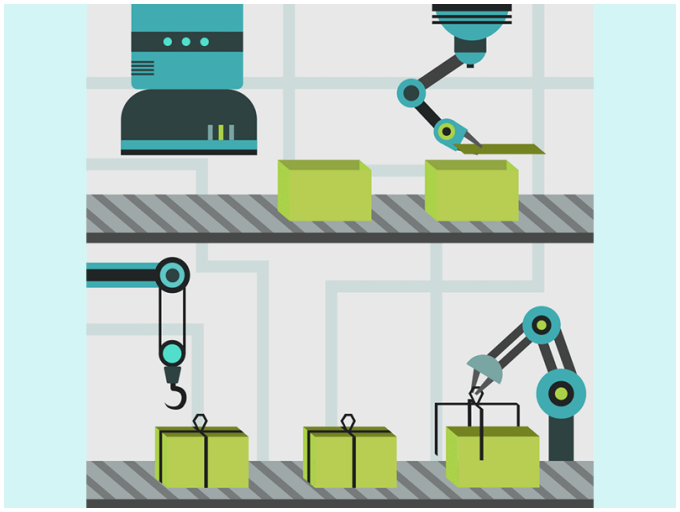




2 to 3 minutes

GENERAL OBJECTIVE (GO)

- Students will be able to understand the basic principle of Computer Numerical Control (CNC) machine, classification and features with desired applications.

2 minutes

SPECIFIC OBJECTIVES (SO) MAPPED WITH STEM

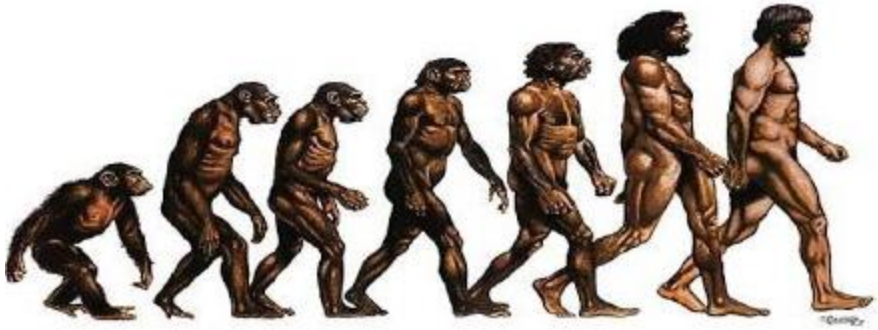
Students will be able to

1. Recognize the prologue of Computer Numerical Control (CNC) machines. (R / F) (T)
2. Explain the basic principle of CNC machines by axes and coordinate system. (U / C) (E)
3. Classify the CNC machine tools. (U / C) (E & T)
4. Exemplify the applications of CNC machines. (U / C) (E & T)

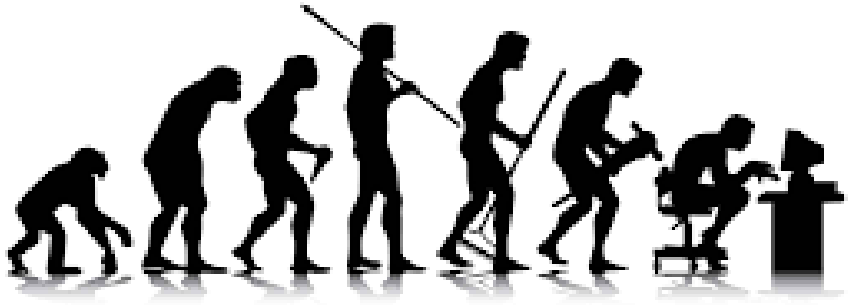
35 to 40 minutes

SO1: Recognize the prologue of Computer Numerical Control (CNC) machines. (R / F) (T)

Human evolution



Now



Evolution of computer

1984
Macintosh

1986
Macintosh Plus

1987
Macintosh II

1987
Macintosh SE

1989
Macintosh IIci

1989
Macintosh IIfx

1990
Macintosh Classic

1990
Macintosh IIsi

1990
Macintosh LC

1993
Macintosh Centris

1993
Macintosh TV

1995
Macintosh LC

1998
iMac

1999
iMac DV

2001
iMac Patterns

2002
iMac

2004
iMac G5

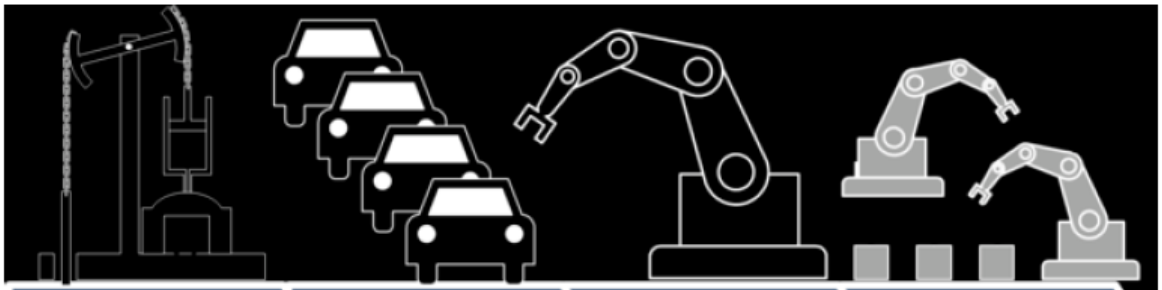
2006
iMac Slimmer Intel

2007
Nuvo iMac

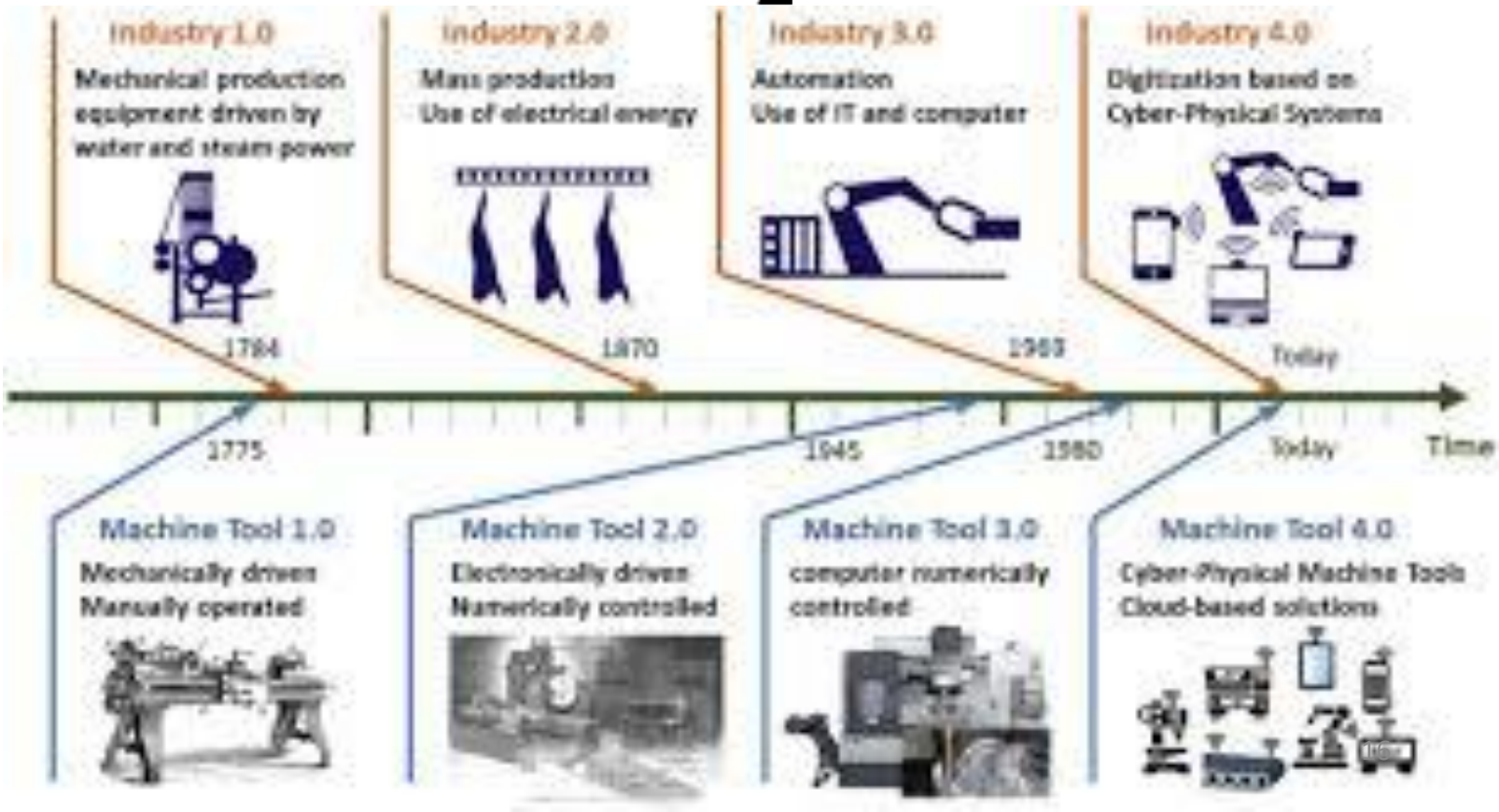
Evolution of the Mobile Phone

Evolution of cycle

Manufacturing changes



1st	2nd	3rd	4th
Mechanization, water power, steam power	Mass production, assembly line, electricity	Computer and automation	Cyber Physical Systems



SO1: Recognize the prologue of Computer Numerical Control (CNC) machines. (R / F) (T)

BRIEF HISTORY OF CNC M/T

Time	Characteristic	Description
Early Industrial Revolution	Basic Concept	J.Jackard's method to control textile looms by using punched cards.
2nd World War	2D Manual Applications	Parson's 2-D Coordinate table operated by two people
1947	1st modern concept	Parsons' NC proposal for milling helicopter rotor blades
1952	1st effectively functioning version	MIT's first NC Milling machine
1956	1st industrial contract	USAF's contract for 100 NC Milling machines to 8 co.s
1956-1962	Difficult years	Big opposition against NC M/T in the contractors of USAF
1961	1st industrial success	Point-to-point control drill pressed
1970	1st CNC	Storing the programs on a computer in add. to tapes.

CNC Machine - INTRODUCTION

- Numerical control (NC) is a method of automatically operating a manufacturing machine based on a code letters, numbers and special characters.
- The numerical data required to produce a part is provided to a machine in the form of program, called part program or CNC (computer numerical control)
- In CNC (Computer Numerical Control), the instructions are stored as a program in a micro-computer attached to the machine.
- The computer will also handle much of the control logic of the machine, making it more adaptable than earlier hard-wired controllers.

Advantages

- High Repeatability, e.g. Aircraft parts.
- Volume of production is very high.
- Complex contours/surfaces need to be machined, e.g. Turbines.
- Flexibility in job change, automatic tool settings, less scrap.
- Safer, higher productivity, better quality.
- Less paper work, faster prototype production, reduction in lead times.
- Easier to program.
- Easy storage of existing programs.
- Avoids human errors.
- Usually generates closer tolerances than manual machines.
- Program editing at the machine tool.
- Tool path verification.

Disadvantages:

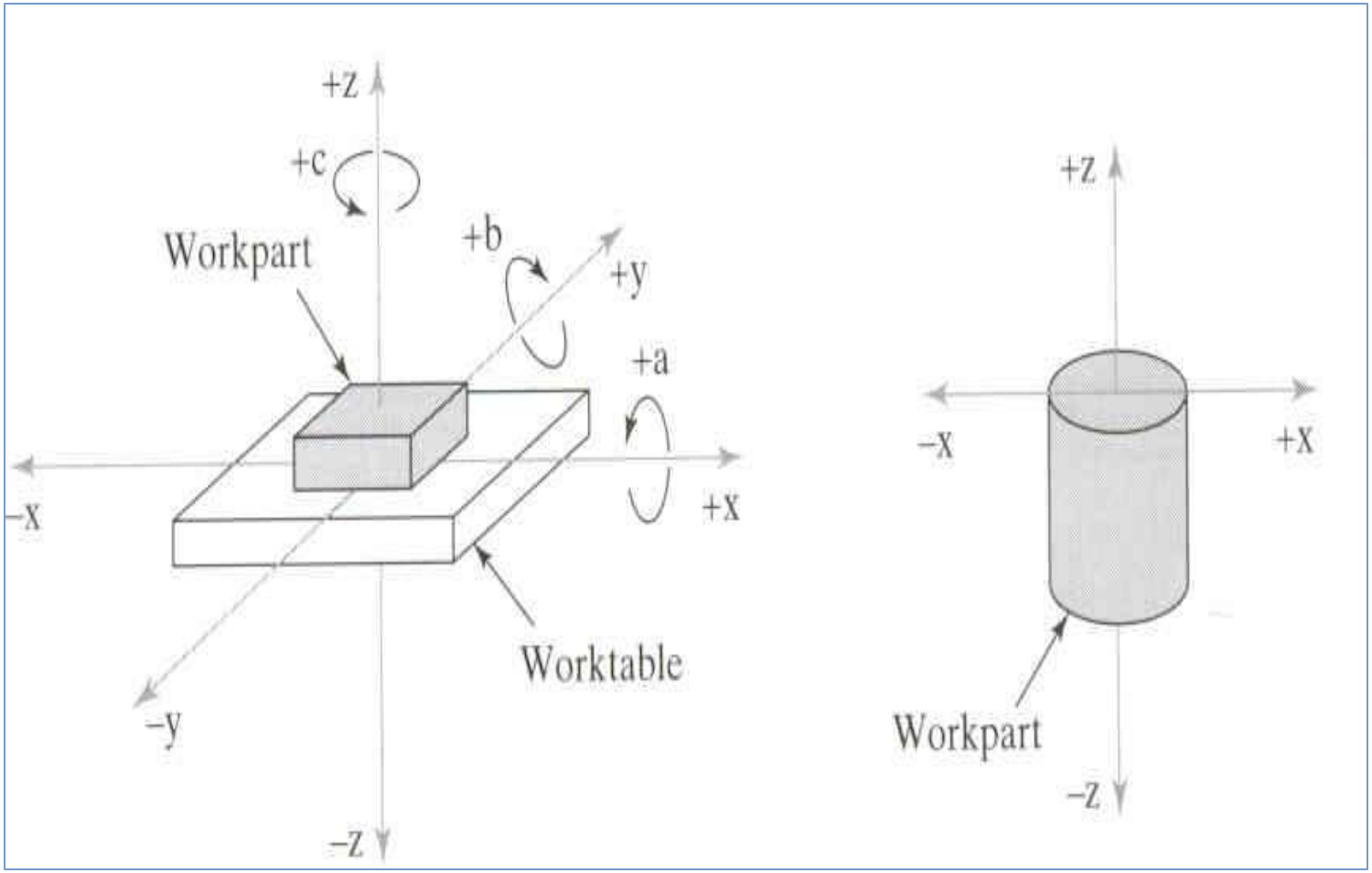
- Costly setup, skilled operators
- Computers, programming knowledge required
- Maintenance is difficult

Features of CNC Machinery

- The tool or material moves.
- Tools can operate in 1-5 axes.
- Larger machines have a machine control unit (MCU) which manages operations.
- Movement is controlled by a motors (actuators).
- Feedback is provided by sensors (transducers)
- Tool magazines are used to change tools automatically.

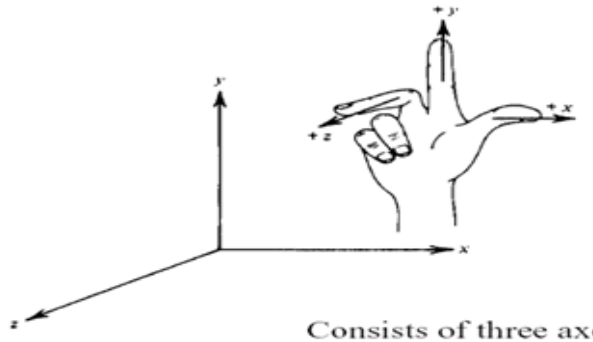
SO2: Explain the basic principle of CNC machines by axes and coordinate system. (U / C) (E)

Basic CNC Principles

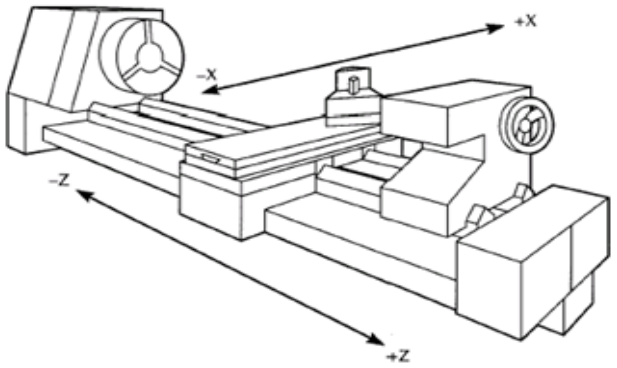


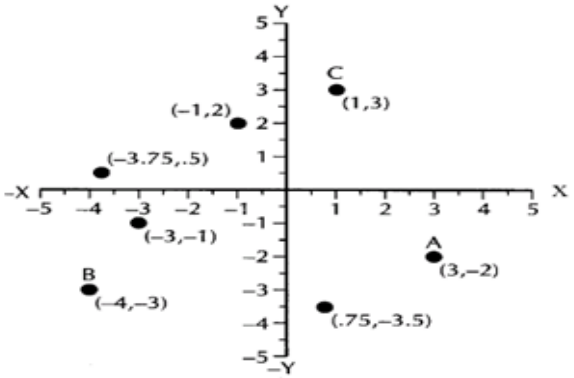
SO2: Explain the basic principle of CNC machines by axes and coordinate system. (U / C) (E)

Basic CNC Principles Coordinates System

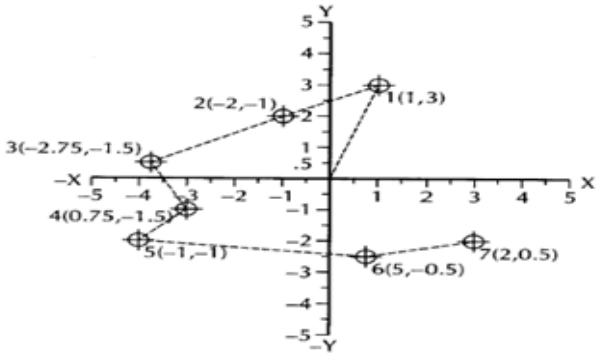


Consists of three axes positioned 90 degrees from each other.





Absolute Coordinate System



Incremental Coordinate System

A 3-AXIS MACHINING CENTER

CLASSIFICATION OF CNC MACHINE TOOLS

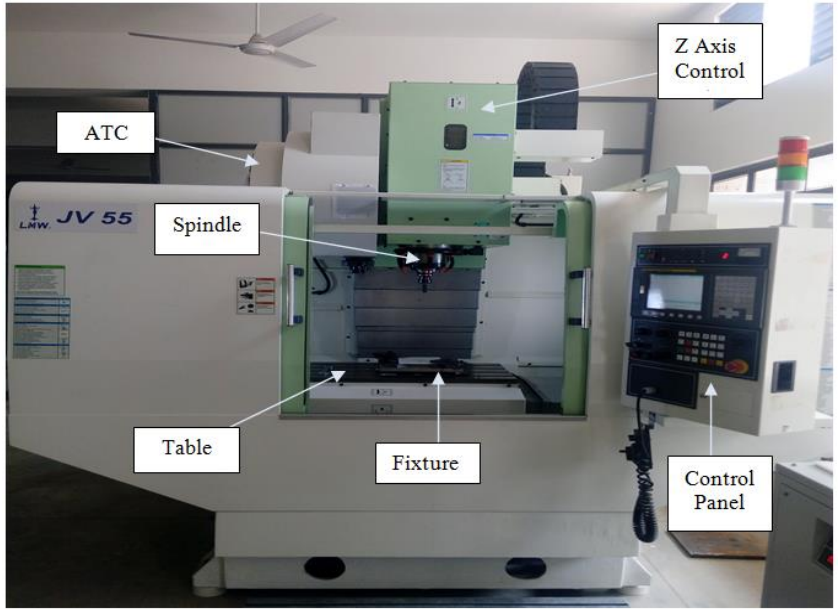
- Based on the motion type
  - Point-to-point system
  - Contouring system (Continuous path systems)
- Based on the control loops
  - Open loop system
  - Closed loop system
- Based on the number of axes
  - 2 axes CNCmachines
  - 3 axes CNCmachines
  - 4 axes CNCmachines
  - 5 axes CNCmachines
- Based on the power supply
  - Electric system
  - Hydraulic system
  - Pneumatic system

CNC APPLICATIONS

- Lathe Machine
- Milling Machine
- Drilling Machine
- Bench Drill Machine
- Pillar Drill Machine
- Boring Machine
- Grinding Machine

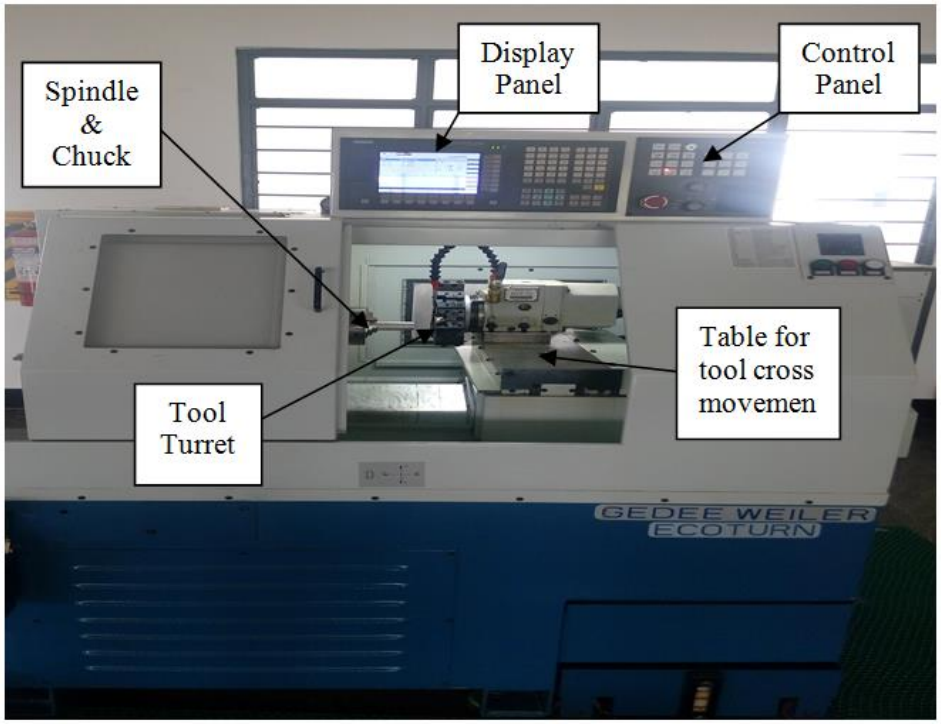
CNC Mills

- These machining centers use computer controls to cut different materials.
- They are able to translate programs consisting of specific number and letters to move the spindle to various locations and depths.
- Used to make 3D prototypes, moulds, cutting dies, printing plates and sights.
- They cut metal that is often turning at fast speeds.



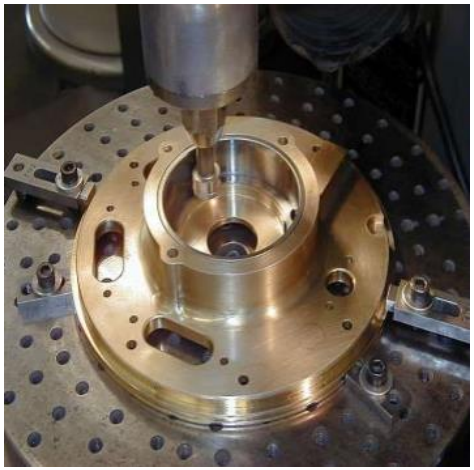
CNC lathes

- CNC lathes are able to make fast, precision cuts using indexable tools and drills with complicated programs. Normally, they cannot be cut on manual lathes.
- They often include 12 tool holders and coolant pumps to cut down on tool wear.



CNC Grinders

- Grinding metal process uses a coated wheel that slowly removes metal to create a part.
- Through the years, grinding was done on a manual machine, but with the advent of CNC technology, the grinding process has advanced.



CNC DRILLING

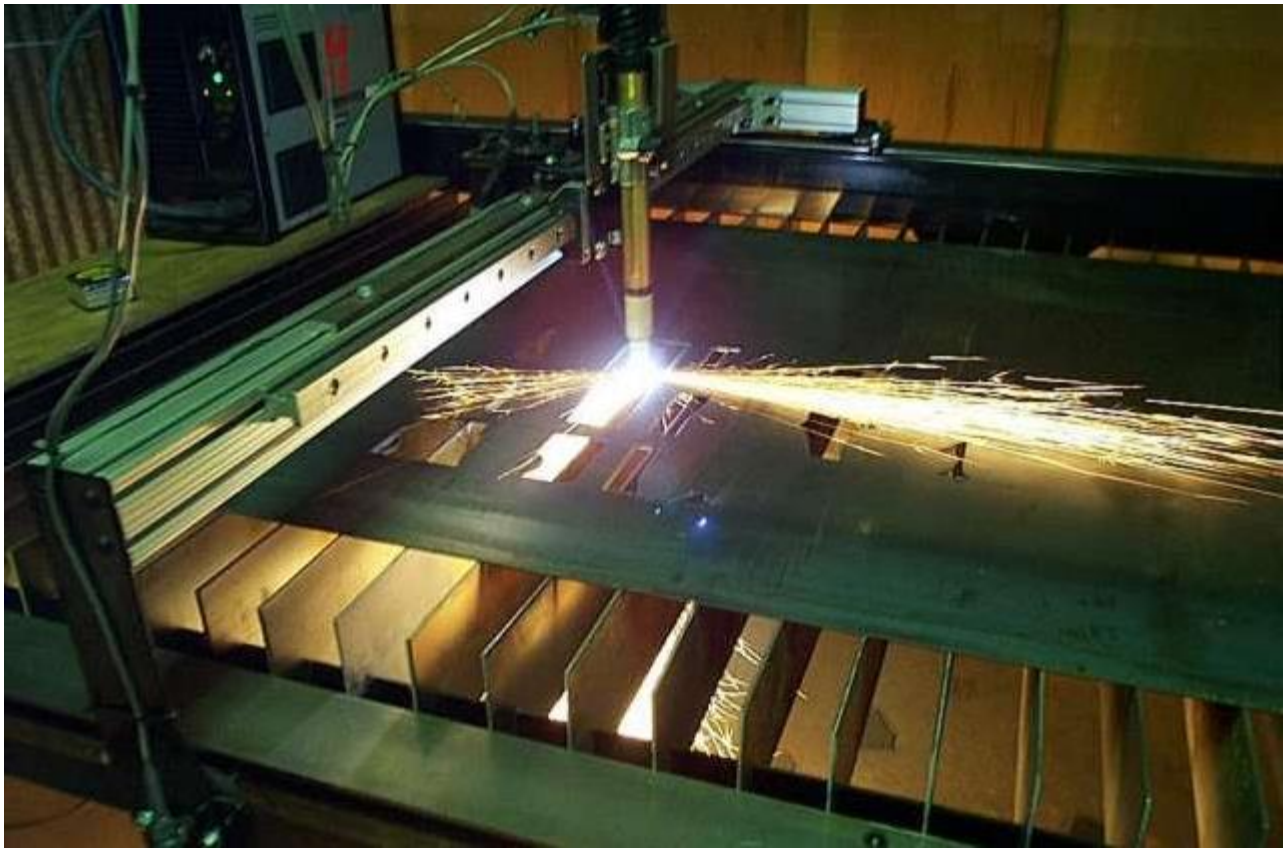
- Drilling is commonly used for mass production. The drilling machine (drilling press) is used to create or enlarge holes.Drilling machine for different jobs;
- The bench drill: For drilling holes through raw materials such as wood, plastic and metal
- The pillar drill: A larger version that stands upright on the floor.
- As the bench drill, it can be used to drill larger pieces of materials and produce bigger holes.

CNC Boring

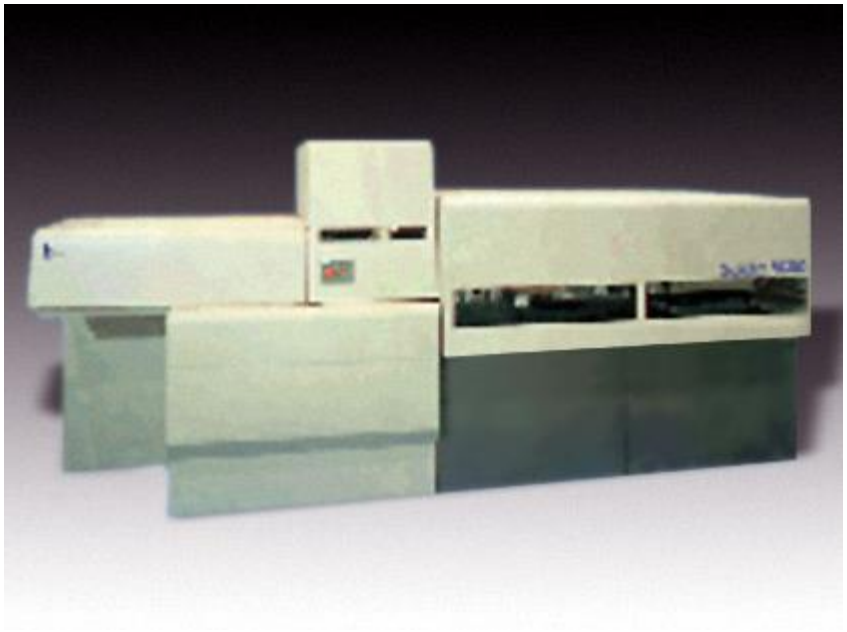
- Process of enlarging an existing hole or internal cylindrical surface.
- This can be accomplished on a lathe or a machine tool specifically designed for the process, such as a horizontal boring machine.

CNC LASER CUTTING

CNC PLASMA CUTTING



CNC PRESS

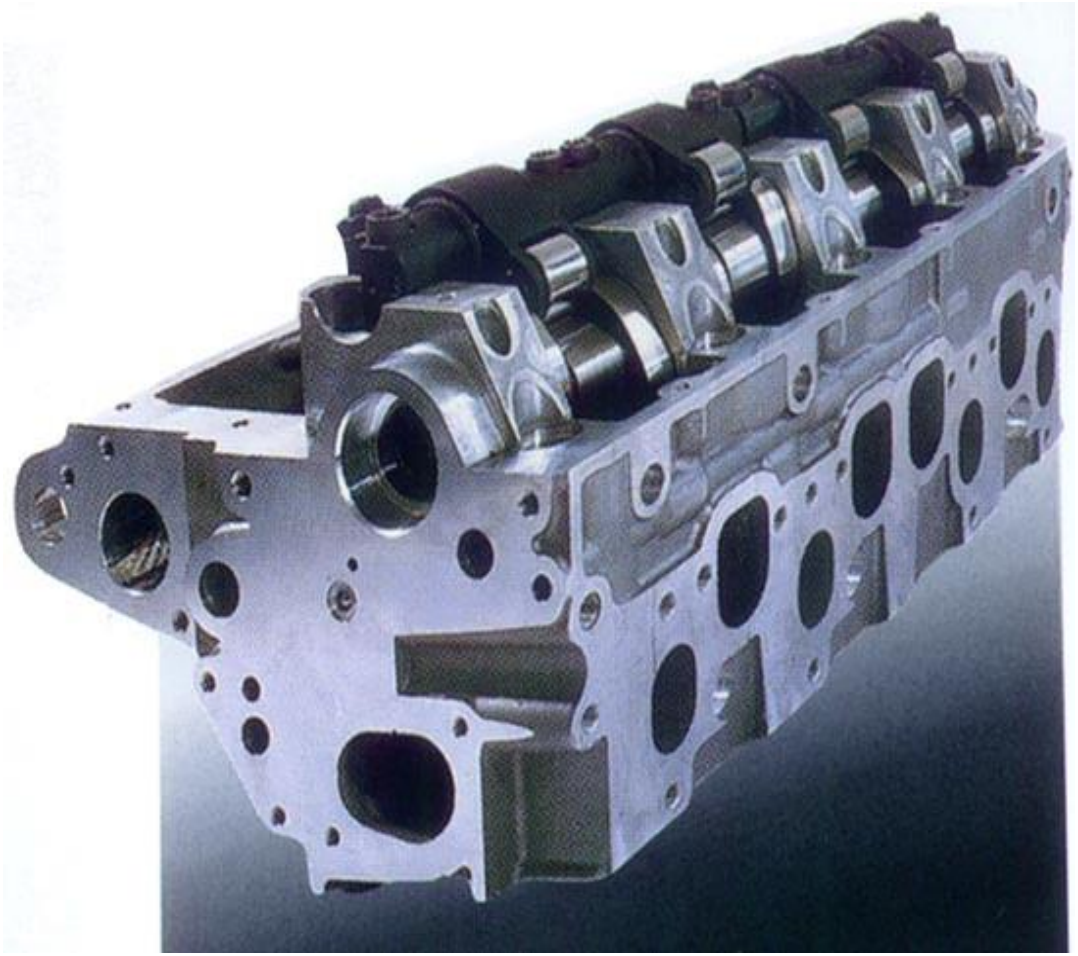


CNC Desired Industries

- ✓ Aerospace
- ✓ Machinery
- ✓ Electrical
- ✓ Fabrication
- ✓ Automotive
- ✓ Instrumentation
- ✓ Mold making

SO4: Exemplify the applications of CNC machines. (U / C) (E & T)

AUTOMOTIVE INDUSTRY



AUTOMOTIVE INDUSTRY

AEROSPACE INDUSTRY

Aircraft Turbine Machined by 5-Axis CNC Milling Machine

CNC MOULD MAKING

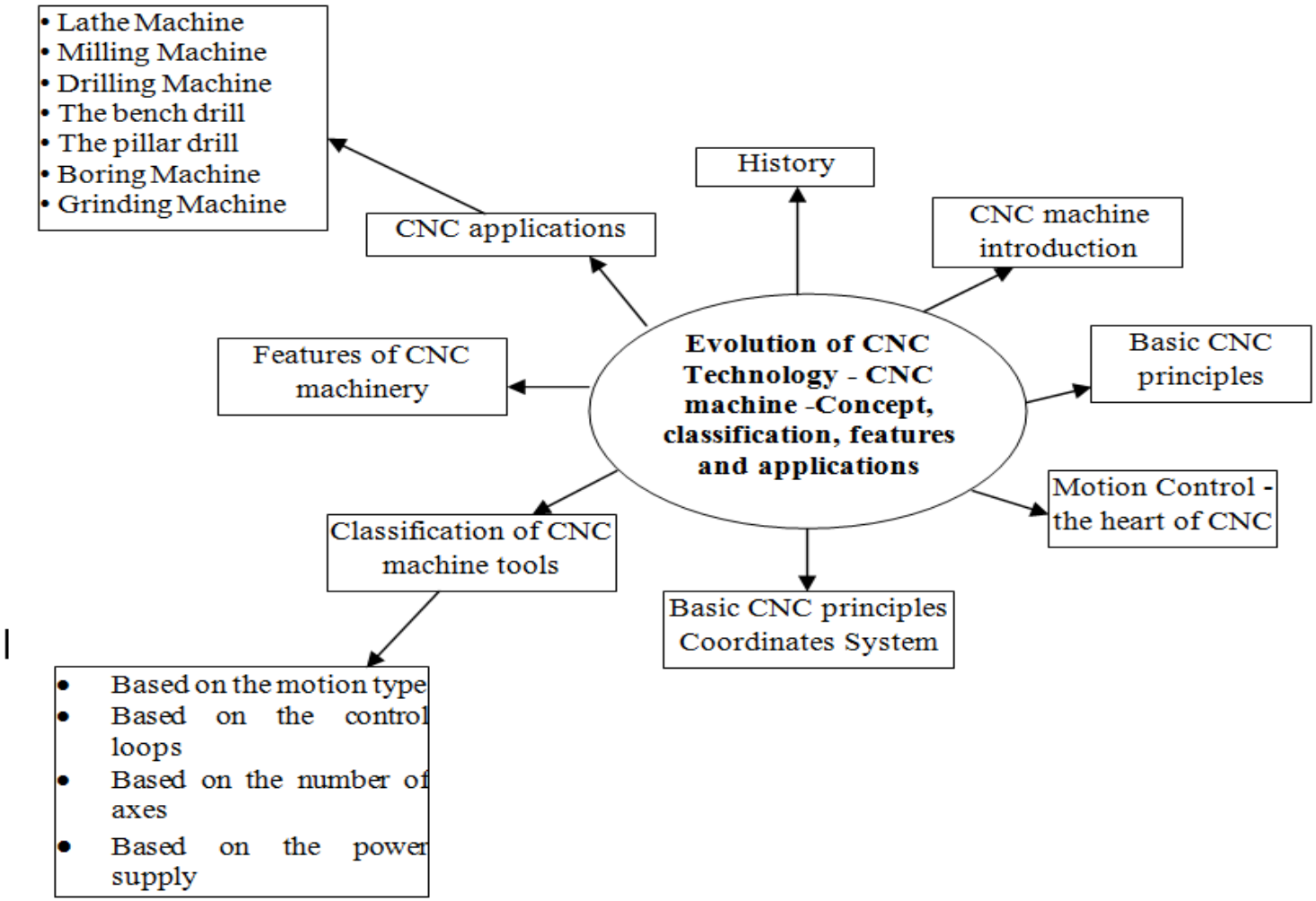
ELECTRONIC INDUSTRY

SO4: Exemplify the applications of CNC machines. (U / C) (E & T)

RAPID PROTOTYPING PRODUCTS

Discussion

MIND MAP



6 to 7 minutes

FORMATIVE ASSESSMENT

Assertion (A): In CNC machines, the operator is always prefer to work with the user coordinate system.
Reason (R): It is not difficult to identify and working with machine (world) coordinate system.

(A) Both A and R are true and R is the correct explanation of A.
(B) Both A and R are true but R is not the correct explanation of A.
(C) A is true but R is false.
(D) A is false but R is true.
(E) Both A and R are false.

(1 Mark-[U/C,3])

FORMATIVE ASSESSMENT

Assertion (A): In CNC machines, the operator is always prefer to work with the user coordinate system.
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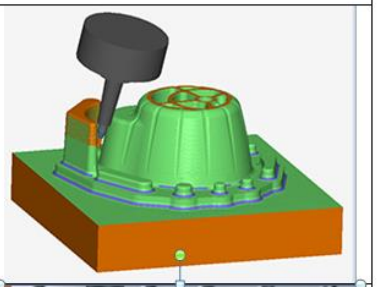
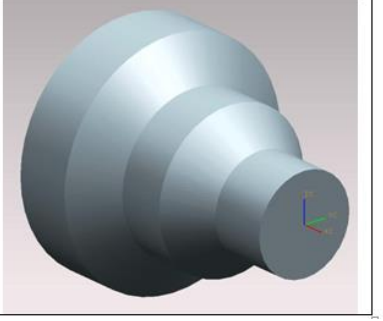
(C) A is true but R is false.
(D) A is false but R is true.
(E) Both A and R are false.

(1 Mark-[U/C,3])

Answer: **(C) A is true but R is false.**

FORMATIVE ASSESSMENT

Match the following:

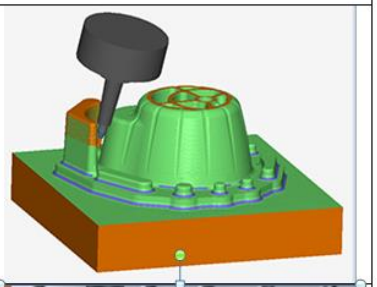
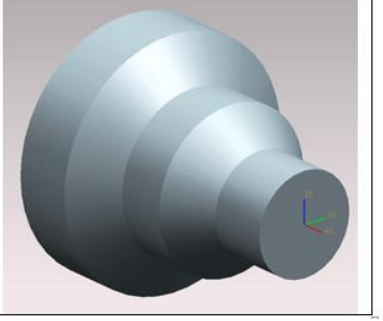
Sl.No.	No. of Axes (A)	Machine (B)	Application (C)
1	Two	Vertical Milling Centre (VMC)	
2	Three	CNC Lathe	
3	Five or Six	CNC Milling	

(A) A1B3C2: A2B1C3: A3B2C1
(B) A1B2C1: A2B2C1: A3B3C2
(C) A1B1C3: A2B3C2: A3B1C3
(D) A1B2C3: A2B3C1: A3B1C2
(E) A1B3C1: A2B2C2: A3B3C1
(F) A1B1C2: A2B3C3: A3B2C2

(3 Marks-[Ap/C,2])

FORMATIVE ASSESSMENT

Match the following:

Sl.No.	No. of Axes (A)	Machine (B)	Application (C)
1	Two	Vertical Milling Centre (VMC)	
2	Three	CNC Lathe	
3	Five or Six	CNC Milling	

(A) A1B3C2: A2B1C3: A3B2C1
(B) A1B2C1: A2B2C1: A3B3C2
(C) A1B1C3: A2B3C2: A3B1C3
(D) A1B2C3: A2B3C1: A3B1C2
(E) A1B3C1: A2B2C2: A3B3C1
(F) A1B1C2: A2B3C3: A3B2C2

(3 Marks-[Ap/C,2])

Answer: **(D) A1B2C3: A2B3C1: A3B1C2**


Thank You