

# CNC MACHINES AND AUTOMATION



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# Chapter 6 (Automation)

# Automation

Automation is a technology concerned with the operation of mechanical, electronic and computer based system to operate and control production

This technology includes:

Automatic machine tool to process parts

Automatic assembly machines

Industrial robots

Automatic material handling and storage systems

Automatic inspection systems and quality control

Feedback control and computer process control

Computer system for planning, data collection and decision making to support mfg. activities

# Benefits of Automation

Reduction or total elimination of tedious and routine operation like loading, unloading, assembly inspection etc.

Creation of new and more interesting jobs

Increase in productive capacity of industry

Greater flexibility through the use of standard production units

Higher living of standards

# Reason of Automation

Increased productivity (Greater output per hour of labor input)

High cost of labor

Labor shortage

Trend of labor towards the service sector

Safety

High cost of raw materials

Improved product quality

Reduced manufacturing lead time

Reduction of in process inventory

# Type of Automation

```
graph TD; A[Type of Automation] --> B[Fixed Automation]; A --> C[Programmable Automation]; A --> D[Flexible Automation];
```

Fixed  
Automation

Programmable  
Automation

Flexible  
Automation

**Fixed Automation:** - The sequence of processing (or assembly) operation is fixed by the equipment configuration

- High initial investment for custom-engineered equipment
- High production rate
- Relatively inflexible in accommodating product changes

Example:     Mechanized Assembly lines (1913)  
                 Machine Transfer lines (1924)

**Programmable Automation:** - Extension of programmable automation. It is a system capable of producing a variety of products with virtual no time loss for changeover from one products to the next.

- High initial investment in general purpose equipment
- low production rate w.r.t. fixed automation
- Flexibility to deal with the change in the product configuration

**Example:** NC machine tools (1952) and industrial robots (1961)



**Flexible Automation:** - Here, the production equipment is designed with the capability to change the sequence of operations to accommodate different product configurations.

- High initial investment in custom-engineered equipment.
- Continuous production of variable mixtures of products.
- Flexibility

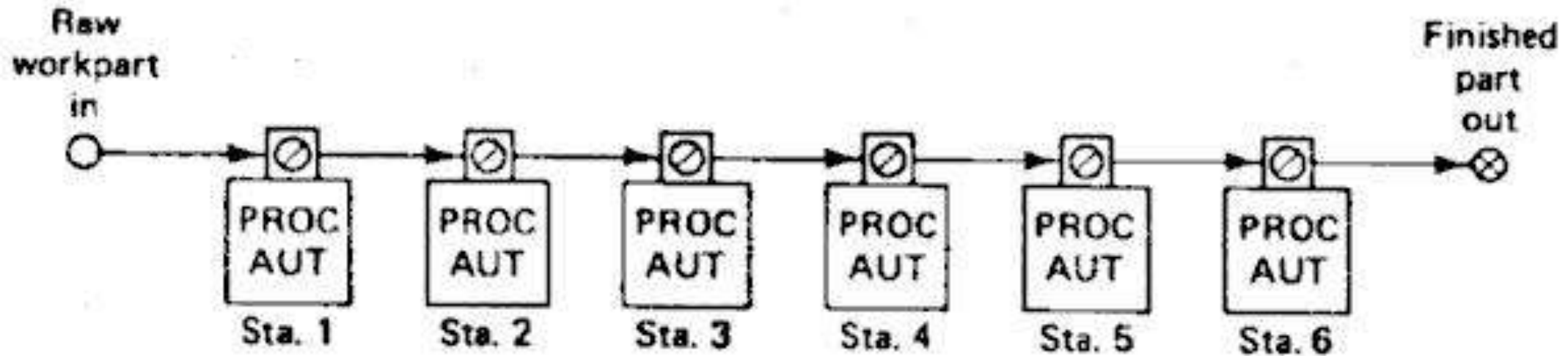
**Example:** FMS (1960)

# Application of Automation

- **Automated Flow Lines**
- **Automated Machining Operations**
- **Automated Assembly Systems (AAS)**
- **Automated Guided Vehicles (AGVs)**
- **Automated Storage and Retrieval System (ASRS)**
- **Automated Identification Systems (AIS)**

# Application of Automation

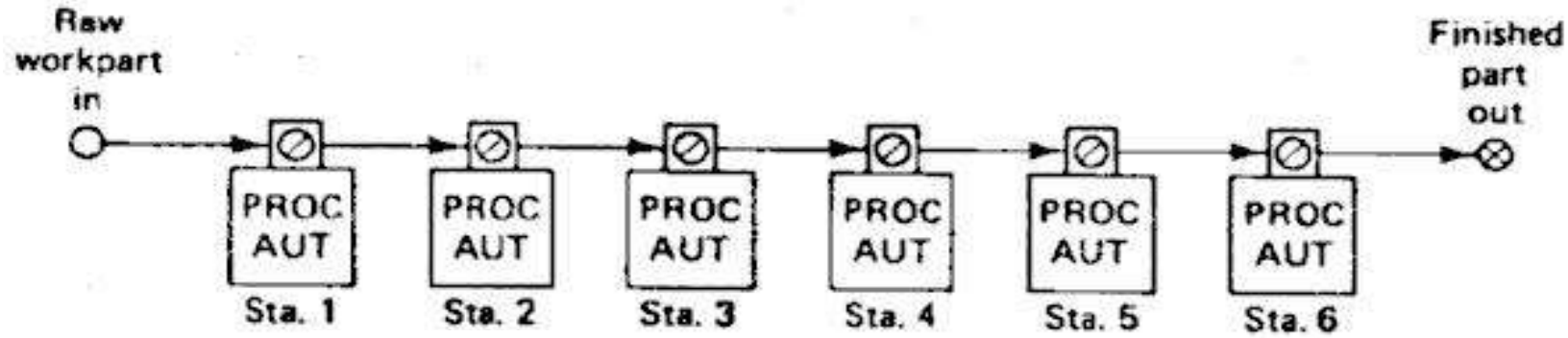
**Automated Flow Lines:** - IT consist of a number of machines linked through automatic transfer devices carrying raw work part at one end and when the process are done on it parts are moved from one workstation to another and finally finished product is taken out at the end of line.



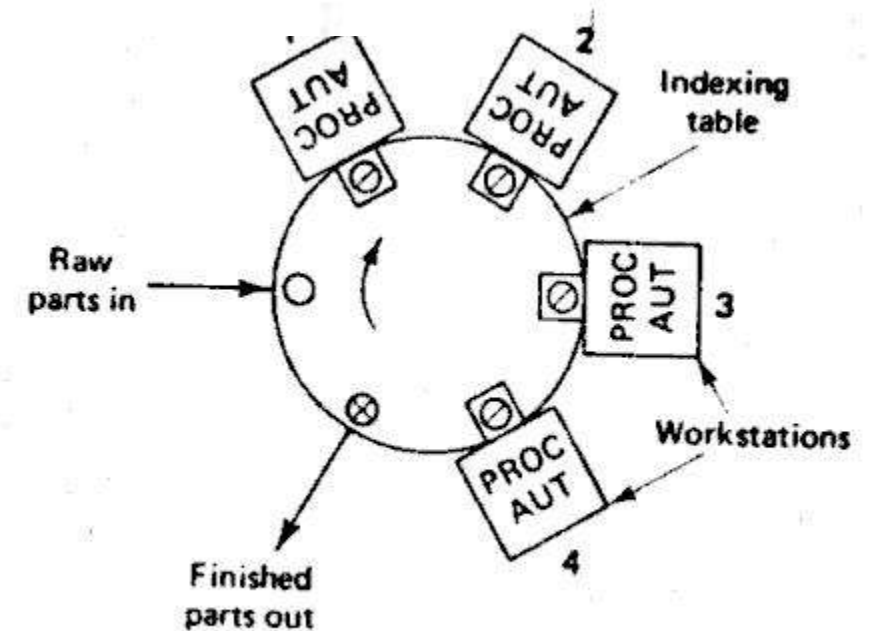
In line flow lines

# Application of Automation

## Automated Flow Lines:



In line flow lines

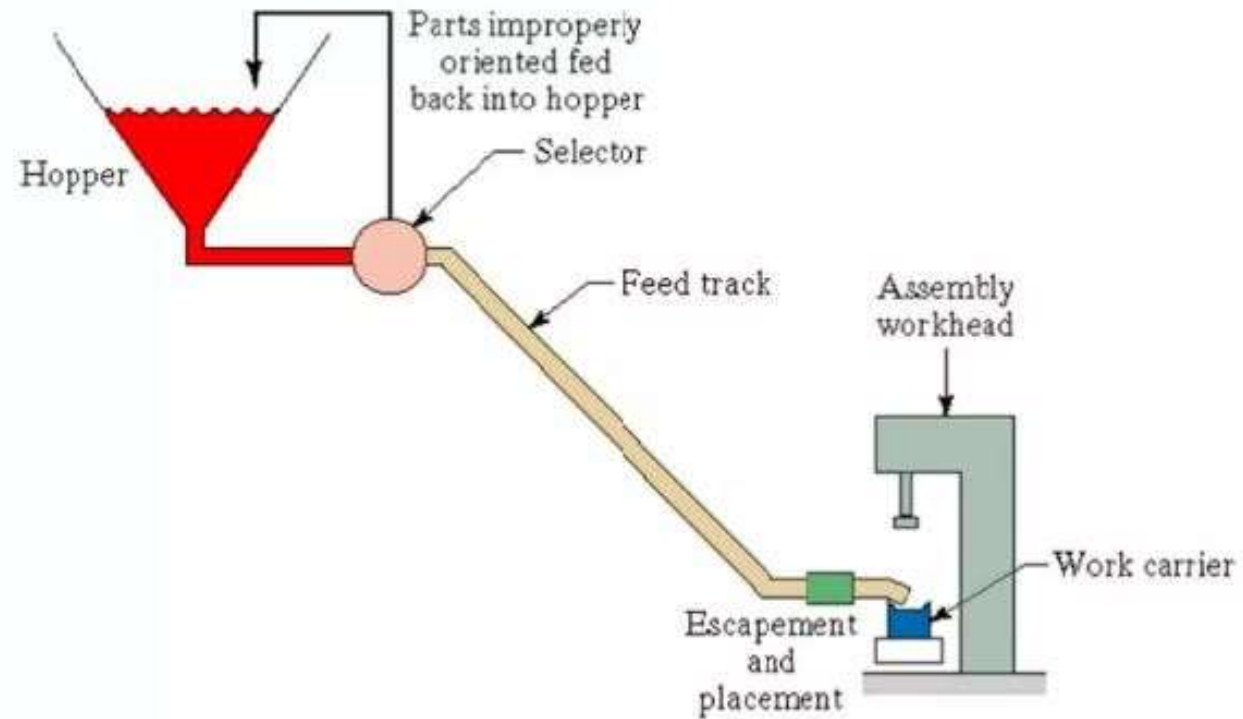


Rotary flow lines

# Application of Automation

## Automated Assembly Systems

### Parts Delivery System at Station



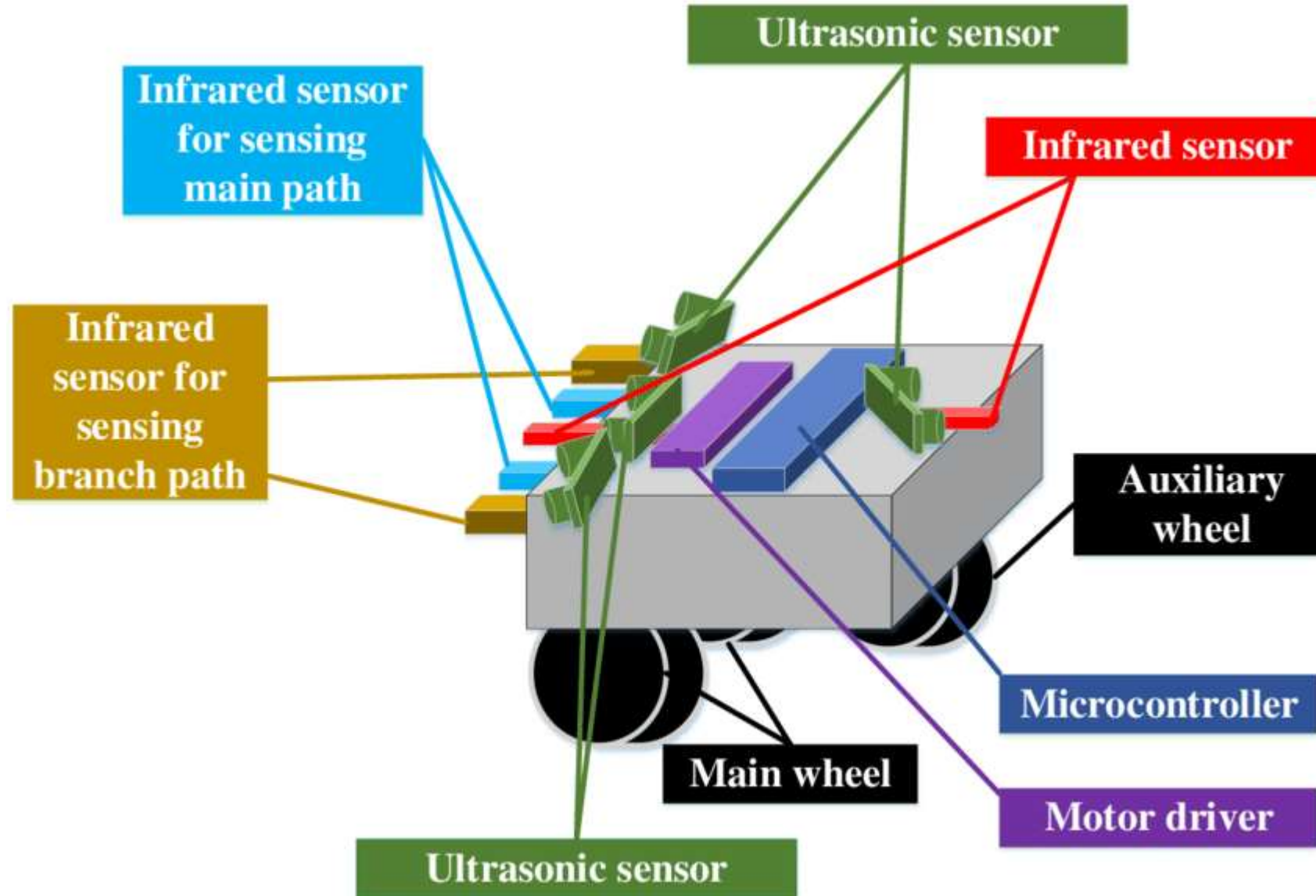
# Application of Automation

## **Automated Guided Vehicles (AGVs):**

AGVs are material handling systems which is used independently operated., self-propelled, that are guided along pre-setted underground pathways or reflecting point or floor surface. The traffic in the route is controlled by the on-board sensor mostly optical or ultrasonic sensor and vehicle stops to avoid collision.

# Application of Automation

## Automated Guided Vehicles (AGVs):



## Type of AGVs

```
graph TD; A[Type of AGVs] --> B[Wire-Guided AGV]; A --> C[Painted-line Guided AGV]; A --> D[Magnetic Guided AGV]; B --- B_desc[Cables 'buried' in rectangular channels under the floor are used to guide these AGVs]; C --- C_desc[These AGVs employ two photo sensors, used to detect the intensity of fluorescence of UV light reflected by a guide line painted by dye]; D --- D_desc[These AGVs use the principle of magnetism to navigate between one location to another location];
```

### Wire-Guided AGV

Cables 'buried' in rectangular channels under the floor are used to guide these AGVs

### Painted-line Guided AGV

These AGVs employ two photo sensors, used to detect the intensity of fluorescence of UV light reflected by a guide line painted by dye

### Magnetic Guided AGV

These AGVs use the principle of magnetism to navigate between one location to another location



# Application of Automation

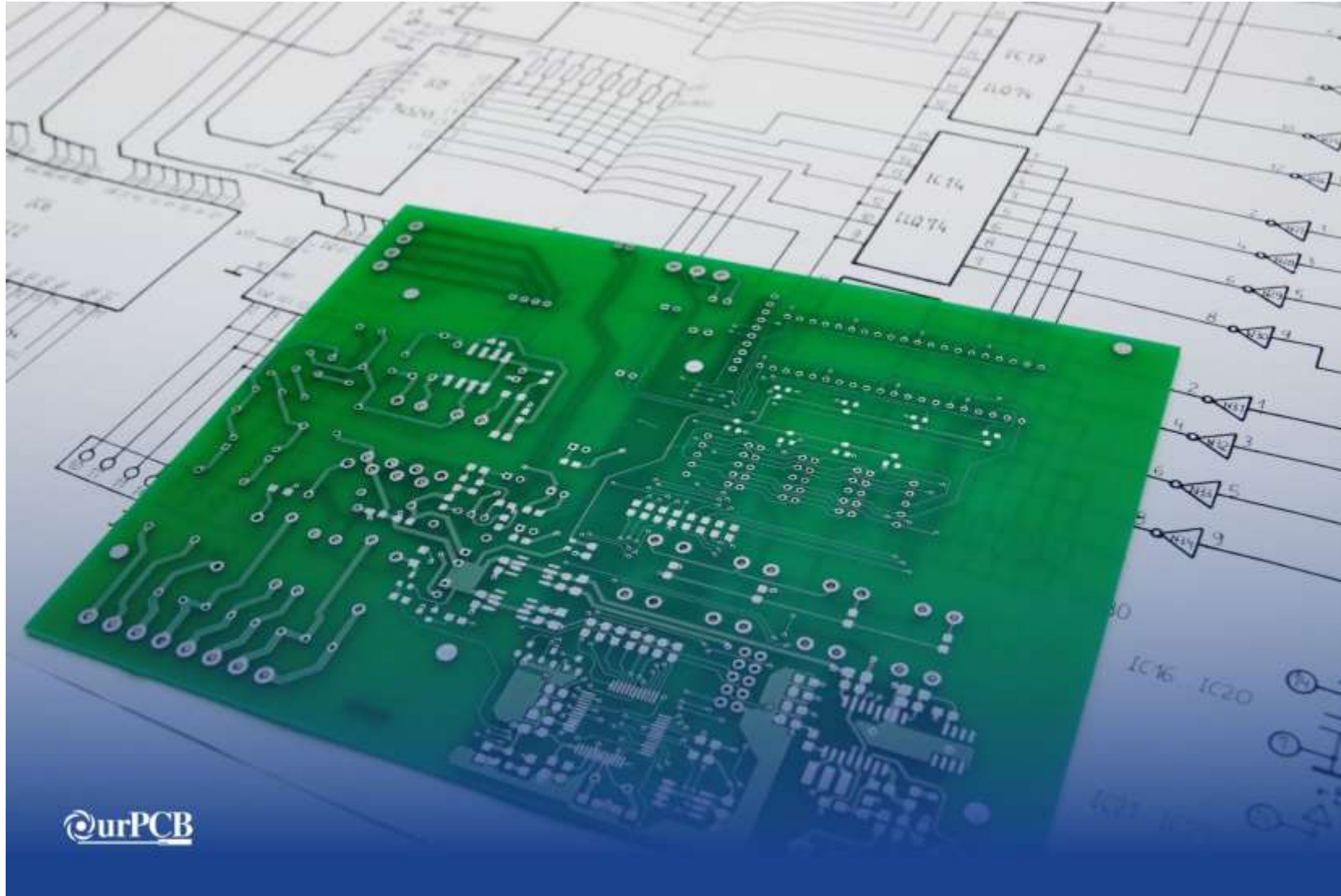
## **Automated Storage and Retrieval System(ASRS):**

It is known by the acronym ASRS, AS-RS, or AS/RS, have the ability to sort, sequence, buffer and store a wide range of goods into virtually unlimited destinations.



# Printed Circuit Board Manufacturing

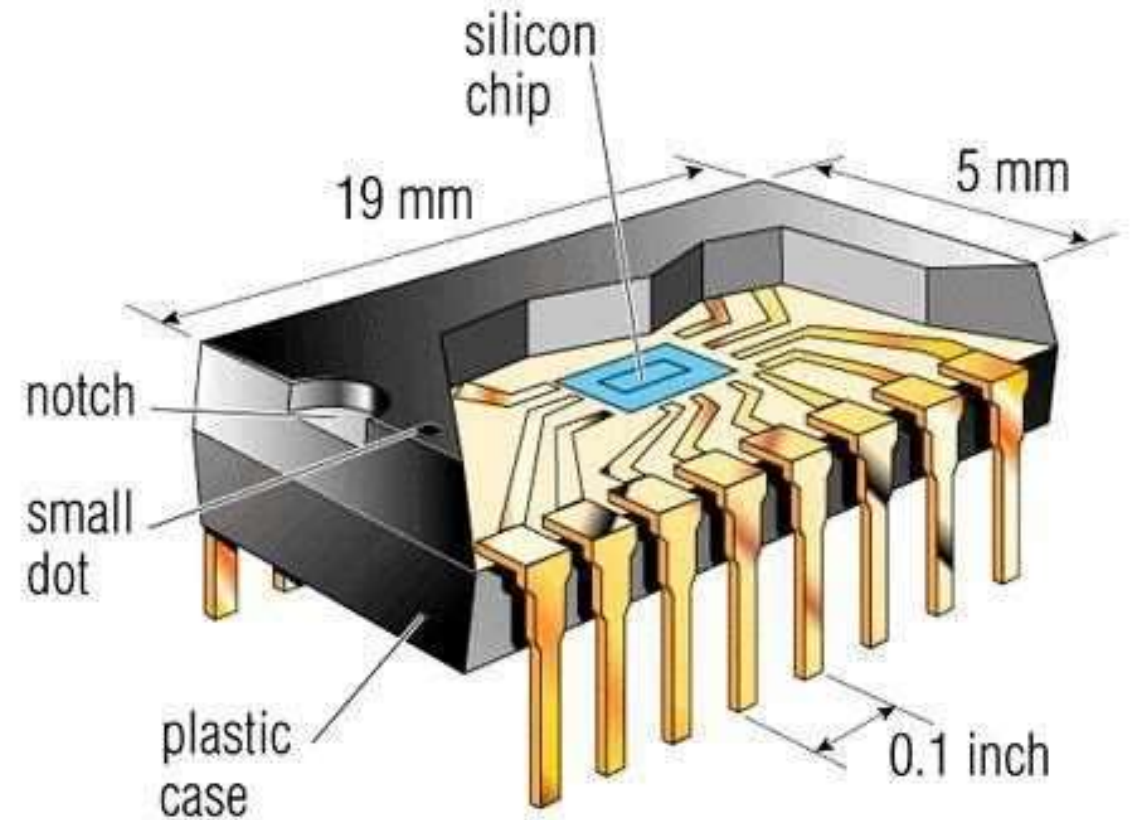
It is electronic circuit created by mounting electronic components on a non-conductive board and creating conductive connection between them.





# Integrated Circuit Manufacturing

The circuit is fabricated within the die and this is mounted in in a suitable package. The die is usually square or rectangular in shape and is fabricated on a wafer. The die has two identifiable areas the periphery and core.



# **Flexible Manufacturing Systems (FMS)**

It is highly automated cell, which consists of a group of processing workstations, interconnected by an automated material handling and storage system and controlled by a distributed computer system

## Type of FMS

- i) Single machine Cell
- ii) Flexible manufacturing Cell

# Group Technology (GT)

GT is a manufacturing concept according to which, various parts being manufactured by a company are placed in small batches or groups as per similarities in their design and manufacturing process.

## ➤ Design Attributes

- Shape
- Geometry
- dimension

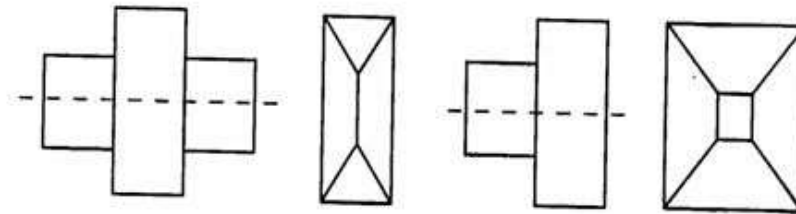
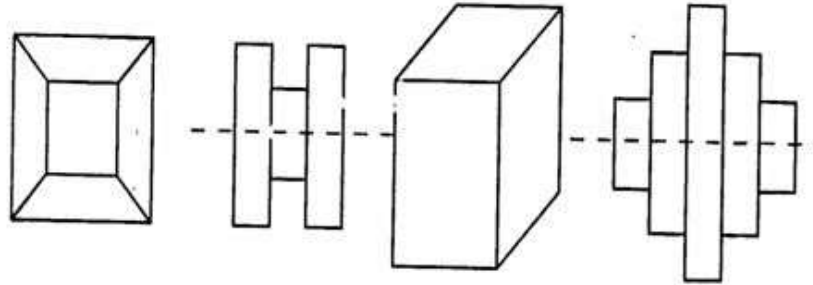
## ➤ Manufacturing Attributes

- Processing method
- Sequence of machining
- Jig and fixture required

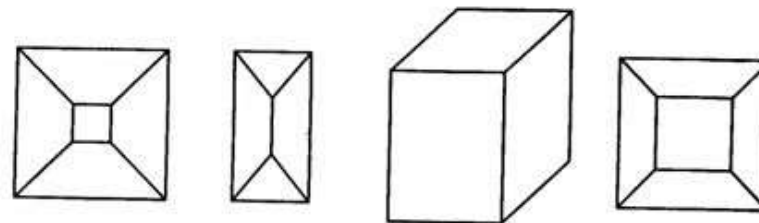
Part Families

# Group Technology (GT)

## Manual visual inspection

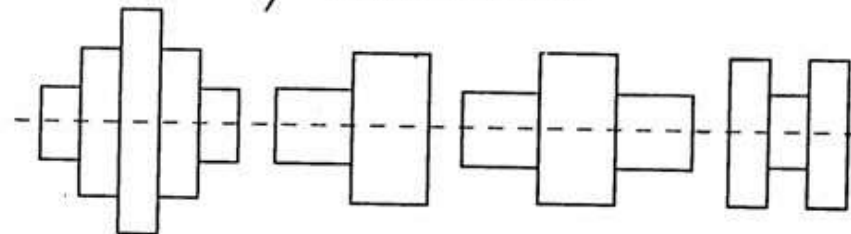


### Part Family 1



Part family 1: Prismatic parts

### Part Family 2



# Group Technology (GT)

## Methods of grouping into part families

- Visual Inspection
- Composite part method
- Production Flow analysis
- Parts classification and coding

# Robotics

A robot is a machine designed to execute one or more tasks automatically with speed and precision

Application of robots

- Assembly line robots
- Heavy duty robots
- Hoisting robots

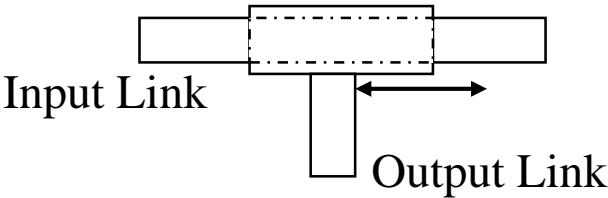


# Robotics

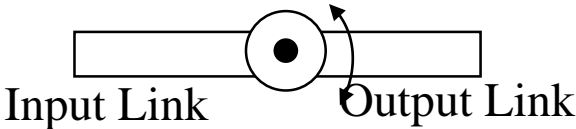
## Robot Joints



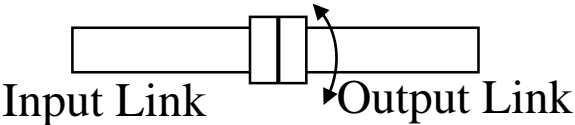
Linear Joint (L)



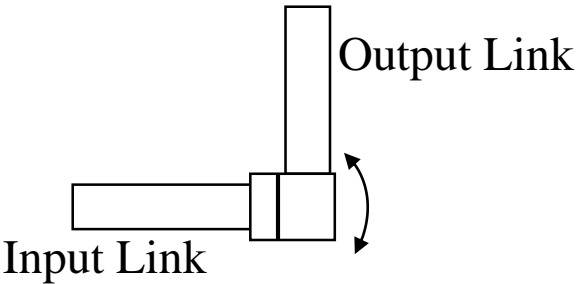
Orthogonal Joint (U)



Rotational Joint (R)



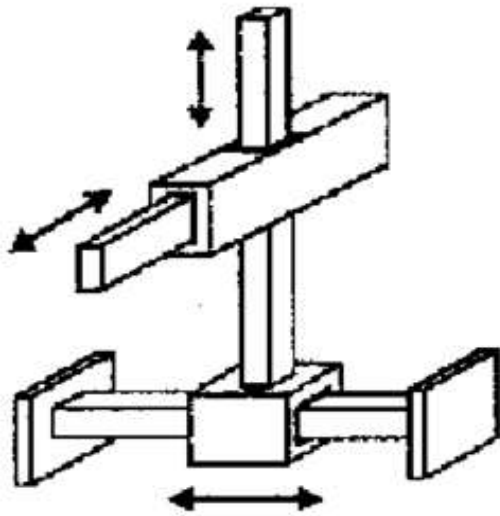
Twisting Joint (T)



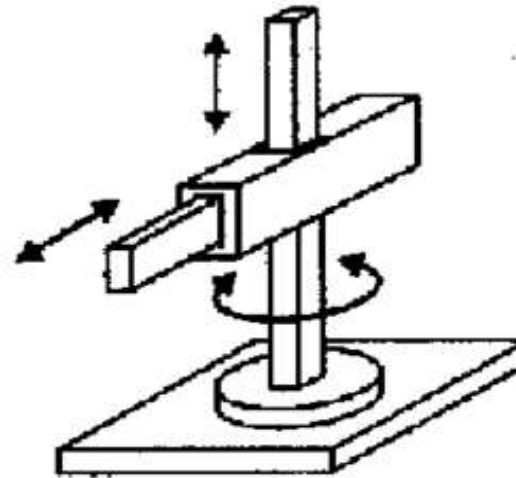
Revolving Joint (V)

# Robotics

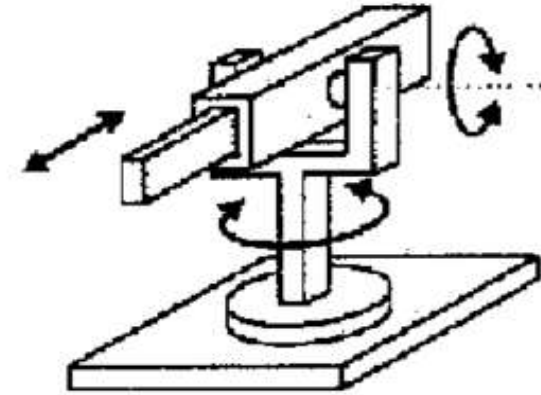
## Common Robotic Joints Motion



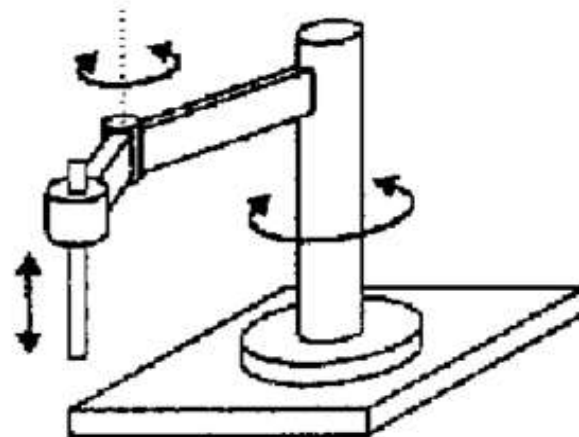
Cartesian Robot



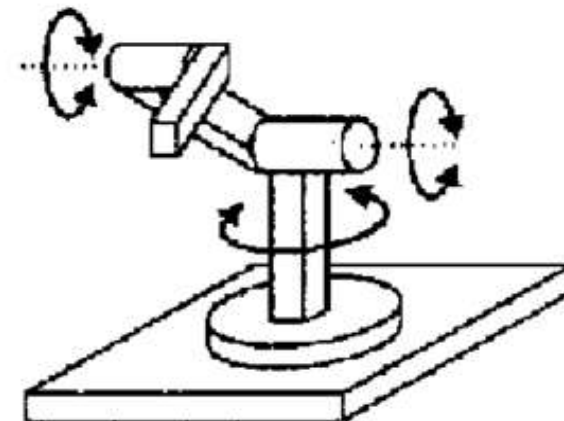
Cylindric Robot



Polar or spheric Robot



SCARA Robot



Angular or anthropomorphic Robot

Thank You