Robot → Came from Czech word: Robota which means forced or slave labores
→ In 1921 Karel Capek used a robot in drama.
→ First commercial, Digital & Programmable robot was built by George Devol (1954).
→ According to International Organization for Standardization (ISO) :-
An automatically controlled, Reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in Industrial automation applications.

→ According to Robot Institute of America (RIA) :-
It is a reprogrammable multi-functional manipulator designed to move materials, parts, tools or specialized devices through variable programmed motions for the performance of variety of tasks.

Note :- A CNC machine is not a robot
→ CNC machine can do more than one task at a time but robot can do only one task at a time.
→ CNC machine have generally 2 or 3 degree of freedom but robot has 6 degree of freedom.
→ In CNC machine coding are done by G code and M code but in robot the method of programing is different.
→ CNC machine is more rigid in comparision with robot.

Robotics → It is a science, which deals with the issues related to design, manufacturing & usages of robot.
→ In robotics we try to copy 3H of humans
H : Hand → In form of manipulator (mech. hand)
H : Head → Intelligence (Artificial)
H ; Heart → Emotion
→ We use robots in manufacturing industries because to
• To Increase productivity
• To Reduce product cost
• Improve product Quality

→ Industrial Robot :-

- An Industrial robot is a robot system used for manufacturing. Industrial robots are automated, programmable and capable of movement on three or more axis.
- Typical applications of robots include welding, painting, assembly, pick & place, packaging, product inspection & testing. All are done with high endurance, speed & precision.

laws of Robot :-

Issac Asimov's Three laws of Robotics :-

→ A robot may not injure the Human Being.

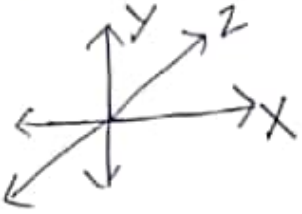
→ A robot must obey the order given by Human except it should not conflict with the 1st Law.

→ A robot must protect its own existence as long as it should not conflict with the 1st & 2nd law.

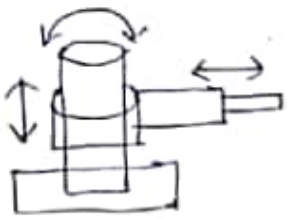
Classification of robots :-

I) According to Geometric classification :-

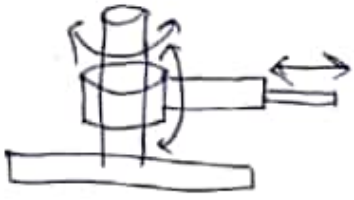
(i) Cartesian/Rectilinear: It moves in X, Y & Z direction. It has three degree of freedom in linear motion only.



(ii) Cylindrical robot : This type of robot is used for round workpiece.
It don't rotate the complete cycle.
→ Work on 2 linear and 1 rotary motion.



(iii) Spherical robot : This type of robot is also used for round workpiece where cylindrical robots are not used.
→ It consist of 2 rotary & 1 linear motion.



Basic Components of Robot →

a) **Manipulator Linkage :-**
- It is a set of links connected by joints either rotating or sliding.
- Best link — end effector
  → Eg. Gripper

b) **Actuators :-**
- It actually help to give motion to all links (joints) or Component of robots.
- Linear or rotating actuator.
- Electrical, Pneumatic or hydraulic power
  Eg. Motors

c) **Transmission :-**
- Element between Actuator & Manipulator linkage

Why we use it

a) Maintain speed of motors
   3000 rpm → 30 rpm (using gears)

b) Convert linear to Rotatory motion or vice-versa.

d) **Sensors :-**

i) Position Sensor ii) Velocity Sensor iii) Acceleration Sensor
iv) Torque Sensor v) Pressure Sensor vi) Vision Sensor
vii) Touch Sensor
[All efficient for control Robots]

e) **Controllers :-**

Provides intelligence to control the whole system
- Memory to store control program
- CPU → Control Commands
- Hardware for use interface & external work
  Eg:- Sensor in TV Remote

f) User Interface :-

- It must have
  - → Display (show status)
  - → I/p Device (Enter command to Robots)

Eg → It may be PC (Personal computer)

g) Power Conversion :-

- Lower power to higher power or vice-versa
- DC to AC or vice-versa.

advantages of robots are listed below:

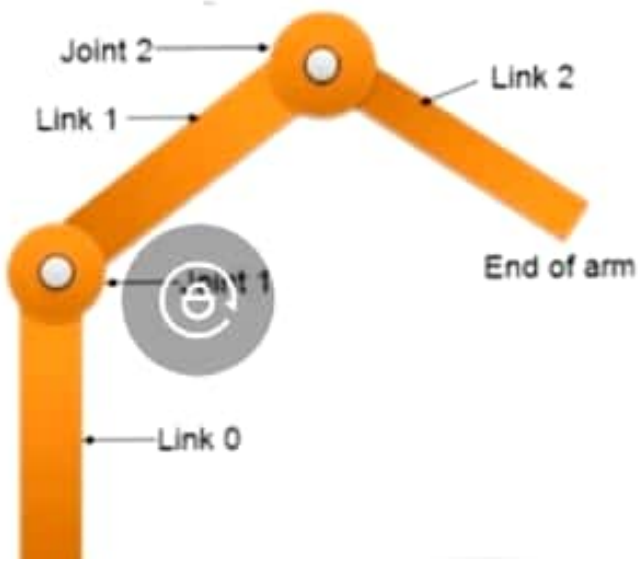
- Robots are good substitutes to the human beings in hazardous or uncomfortable work environments.
- A robot performs its work cycle with a consistency and repeatability which is difficult for human beings to attain over a long period of continuous working.
- Robots can be reprogrammed. When the production run of the current task is completed, a robot can be reprogrammed and equipped with the necessary tooling to perform an altogether different task.
- Robots can be connected to the computer systems and other robotics systems. Nowadays robots can be controlled with wire-less control technologies. This has enhanced the productivity and efficiency of automation industry.

2. Robot anatomy and related attributes

2.1 Joints and Links

The manipulator of an industrial robot consists of a series of joints and links. Robot anatomy deals with [redacted] ulator's physical construction. A robotic joint provides relative motion between two links of the robot. Each joint, or axis, provides a certain degree-of-freedom (dof) of motion. In most of the cases, only one degree-of-freedom is associated with each joint. Therefore the robot's complexity can be classified according to the total number of degrees-of-freedom they possess.

Each joint is connected to two links, an input link and an output link. Joint provides controlled relative movement between the input link and output link. A robotic link is the rigid component of the [redacted] base, such as the floor. From this base, a joint-link numbering scheme may be recognized as shown in Figure 7.5.1. The robotic base and its connection to the first joint are termed as link-0. The first joint in the sequence is joint-1. Link-0 is the input link for joint-1, while the output link from joint-1 is link-1—which leads to joint-2. Thus link 1 is, simultaneously, the output link for joint-1 and the input link for joint-2. This joint-link-numbering scheme is further followed for all joints and links in the robotic systems.



Nearly all industrial robots have mechanical joints that can be classified into following five types as shown in Figure 7.5.2.

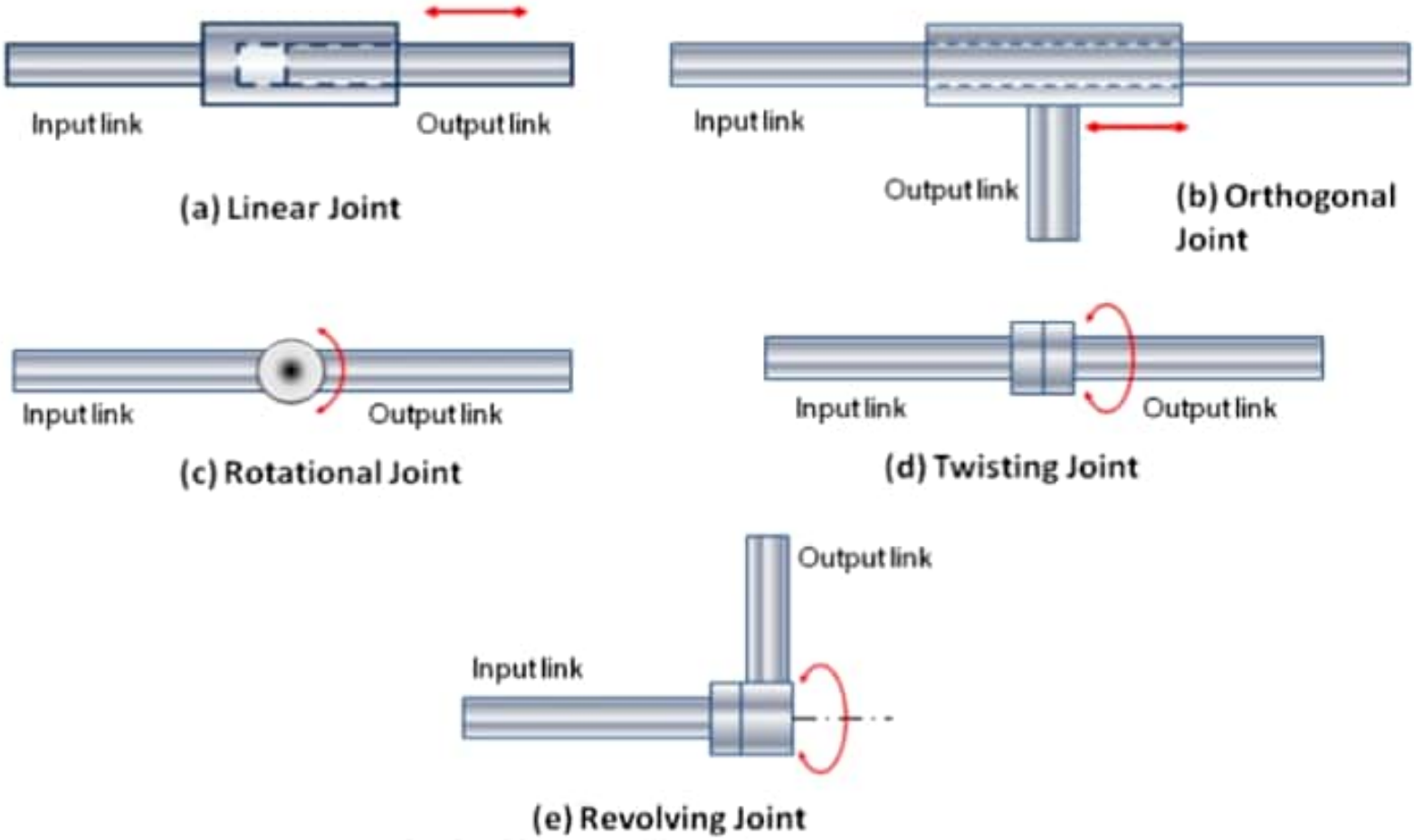


Fig. 7.5.2 Types of Joints

a) Linear joint (type L joint)

The relative movement between the input link and the output link is a translational sliding motion, with the axes of the two links being parallel.

b) Orthogonal joint (type U joint)

This is also a translational sliding motion, but the input and output links are perpendicular to each other during the move.

c) Rotational joint (type R joint)

This type provides rotational relative motion, with the axis of rotation perpendicular to the axes of the input and output links.

d) Twisting joint (type T joint)

This joint also involves rotary motion, but the axis or rotation is parallel to the axes of the two links.

e) Revolving joint (type V-joint, V from the "v" in revolving)

In this type, axis of input link is parallel to the axis of rotation of the joint. However the axis of the output link is perpendicular to the axis of rotation.

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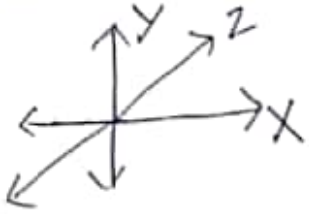

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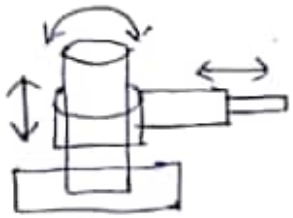

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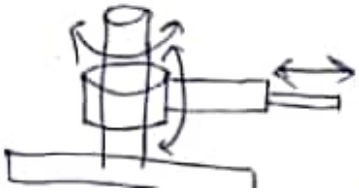
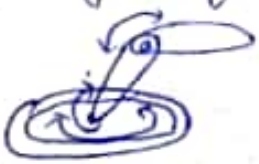


(iv) Joined Arm robot :- This type of robot only perform rotary motion. This type of robot have 3 rotary motion.



(v) SCARA robot :- SCARA Robot has 3 rotary motion & 1 linear motion. It is mainly use for pick & place of any object.

⇒ According to the usage in different fields.

(i) Industrial Robot :- Used in welding, material handling, productivity
(ii) Educational Robot → Used in education. Ex:- Robolab, Lego etc.
(iii) Domestic robot → Used in home such as modern programmed toys which can talk, dance etc.