Robotics

Robot – Automatically controlled, reprogrammable and multipurpose machine.

In Robotics, we try to copy hand, head, and heart of human beings.
Robots are available in forms of manipulator, wheeled robots (moving base), multi-legged robots, Tracked vehicle, Drone etc.

Introduction to Robots and Robotics –

Difference in Robot & Robotics –

The term Robot came from a Czech word – **ROBOTA**, which means forced or slave laborer.

In 1921, Karel Capek (Czech Playwright) first used this term in his Drama R.U.R. (Rossum's Universal Robots). According to him, Robot is a machine which is in look wise similar to human being. (But today we use some of the Robots which do not look like human being)

Definition of Robot –

1) A machine capable of carrying out a complex series of actions automatically, especially one programmable by a computer. (oxford English Dictionary)
2) An automatically controlled, reprogrammable, multi-purpose manipulator programmable in three, or more axes which can be either fixed in place or mobile for use in industrial automation applications. (By ISO)
    (Manipulator – with fix base)
3) It is a reprogrammable multi-functional manipulator designed to more materials, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks. (By Robot Institute of America)

Note : CNC Machine is not a Robot.

Because Reprogrammability level of Robot is higher than that of CNC.

Robotics – It is a science, which deals with the issues related to design, manufacturing, and usage of Robots.
In 1942, the term Robotics was introduced by ISAAC Asimov in his story named **Runaround**.

Robotics uses fundamentals of –
  – Physics
  – Electrical Engineering
  – Mathematics
  – Computer Science
  – Mechanical Engineering
  – Electronic Engineering

3Hs of Robotics, which is being copied from human beings –

* Hand – Manipulator
* Head – Intelligence
* Heart – Emotions

Brief History –

1954 – First Patent on Manipulator by George Devol (father of Robot) [first programmed Robot]

1956 – Joseph Engel Berger started first Robotics Company (UNIMATION)

1962 – General Motors used the manipulator (UNIMATE in die – casting application)

1967 – General Electric Corporation made a 4-legged vehicle.

1969 – SAM was built by the NASA, USA. SHAKEY, an intelligent mobile robot, was built by Stanford Research Institute (SRI).

1970 – Victor Scheinman demonstrated a manipulator known as Stanford Arm.
      Lunokhod I was built and sent to the moon by USSR.
      ODEX 1 was built by Odetics.

1973 – Richard Hohn of Cincinnati Milacron Corporation manufactured T^3 (The Tomorrow Tool) Robot.

1975 – Raibart at CMU, USA built a one-legged hopping machine, the first dynamically stable machine.

1978 – Unimation developed PUMA (Programmable universal machine for Assembly or Programmable Universal Manipulation Arm.

1983 – Odetics introduced a unique experimental six legged device.

1986 – ASV (Adaptive suspension vehicle) was developed at Ohio State University, USA.

1997 – Pathfinder and Sojourner was sent to the mars by NASA, USA. [mission failed].

2000 – Asimo Humanoid Robot was developed by Honda.

Classification of Robots –

(A) Based on the type of tasks performed -

1. **Point to Point Robots –** When the tool is not in touch with the job continuously, this is known as point to point task, and the Robot doing such task is known as point to point Robot.
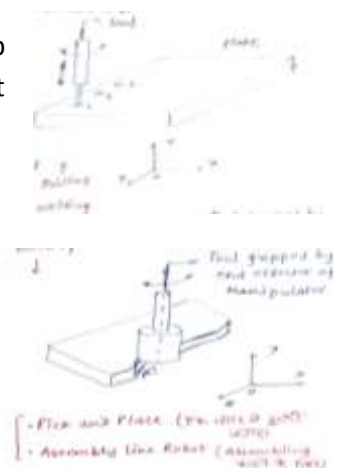   **Eg :-** Unimate 2000
   T^3 (The Tomorrow Tool)

2. **Continuous Path Robots –** When the tool will be in touch with the job continuously, and the Robot doing such task is known as continuous path Robots.
   Eg :- PUMA
   CRS

Note :- Continuous path Robot can be used as a point to point Robot but the Reverse is not true.

(B) Based on the type to controller –

1. **Non-Servo Controlled Robots –** In this type of Robots, the error is neither measured nor compared and feedback for the purpose of compensation of this error. [open – loop control system]
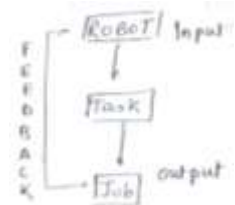   Eg :- Seiko PN – 100
   Less accurate and Less expensive

2. **Servo Controlled Robots –** Robots in which some feedback devices are used [closed loop control system]
   Eg :- Unimate 2000, PUMA, T^3
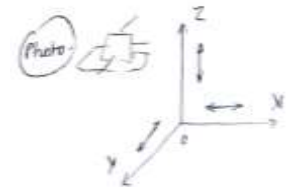   - More accurate and more expensive

(C) Based on Configuration (Co-ordinate System) of the Robot –

1. **Cartesian Co-ordinate Robots –** these types of Robots have linear movement along three different axis having either sliding or prismatic joints i.e. SSS or PPP which are rigid and accurate.
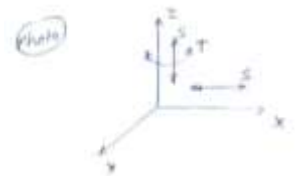   It is suitable for Pick and Place type of operations.
   Eg :- IBM's RS-1, Sigma Robot

2. **Cylindrical Co-ordinate Robots –** these types of Robots have 2 linear and one Rotary movements represented as TPP, TSS.
   It is used to handle parts/objects in manufacturing. It cannot reach the object lying on the floor. It has poor dynamic performance.
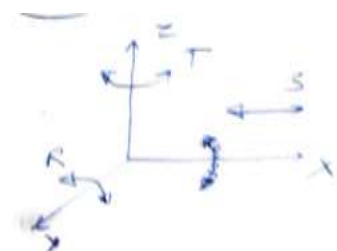   **Eg :-** Versatran 600

3. **Spherical Co-ordinate or Polar Co-ordinate Robots –** This type of Robots have 1 linear and 2 Rotary movement, represented as TRP, TRS which are suitable for handling parts/object in manufacturing.
   It can pick up objects lying on the floor. It has poor dynamic performance.
   Eg:- Unimate 2000 B

Application of Robots –

1) In Manufacturing Units – (Advantages of Robots)
- Robots can work in hazardous and dirty environment.
- Can increase productivity after maintaining improved quality.
- Direct Labour cost will be reduced.

- Material cost will be reduced.
- Repetitive tasks can be handled more efficiently.

Application Areas – Welding, Pick and Place operations, Grinding, Drilling etc.

Note – 1. Robots are developed in form of ROV (Remotely Operated Vehicle) and AUV (Autonomous Under Water Vehicle)

ROV – having a central control

AUU – No central control

2. Robots are equipped with navigational sensors, propellers/thrusters, on-board software etc.

2) Medical Applications –

- Tele-surgery
- Micro-capsule multi legged Robots
- Prosthetic devices/orthotics

Tele-surgery – There is a physical distance between the doctor and the patient, and with help of these Robots, the doctor is carries out operations. (Say 5 km away)
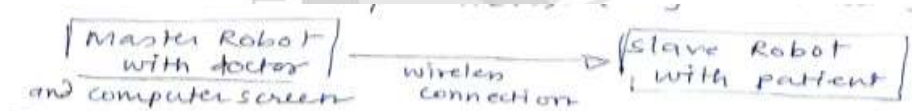
Micro capsule multi legged Robot – with very small cameras can go inside the body and can give into about the digestive system of patient.
(For finding location of Tumor)
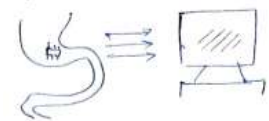
3) Space Application -

- For carrying out on-orbit services, assembly job and interplanetary missions.
- Space Craft deployment and retrieval, survey of outside space shuttle; assembly, testing, maintenance of space stations, transport of astronauts to various locations.
- Robo – nauts
- Free – flying Robots (Very small)
- Planetary exploration Rovers

4) In Agriculture –

- For spraying Pesticides, Fertilizers.
- Cleaning weeds.
- Souring seeds.
- Inspection of Plants.

5) Some other Application -

- Replacement of maid-servant
- Garbage collection
- Underground coal mining
- Sewage-line cleaning
- Fire fighting etc.