Vishwakarma Institute of Technology

Department of Engineering, Sciences and Humanities

FY – 2019-2020 – Term 1

Robot Mechanics and Control – IMP points

Introduction

A) Origin of the word Robot, History of Robotics, Anatomy of a Robot.

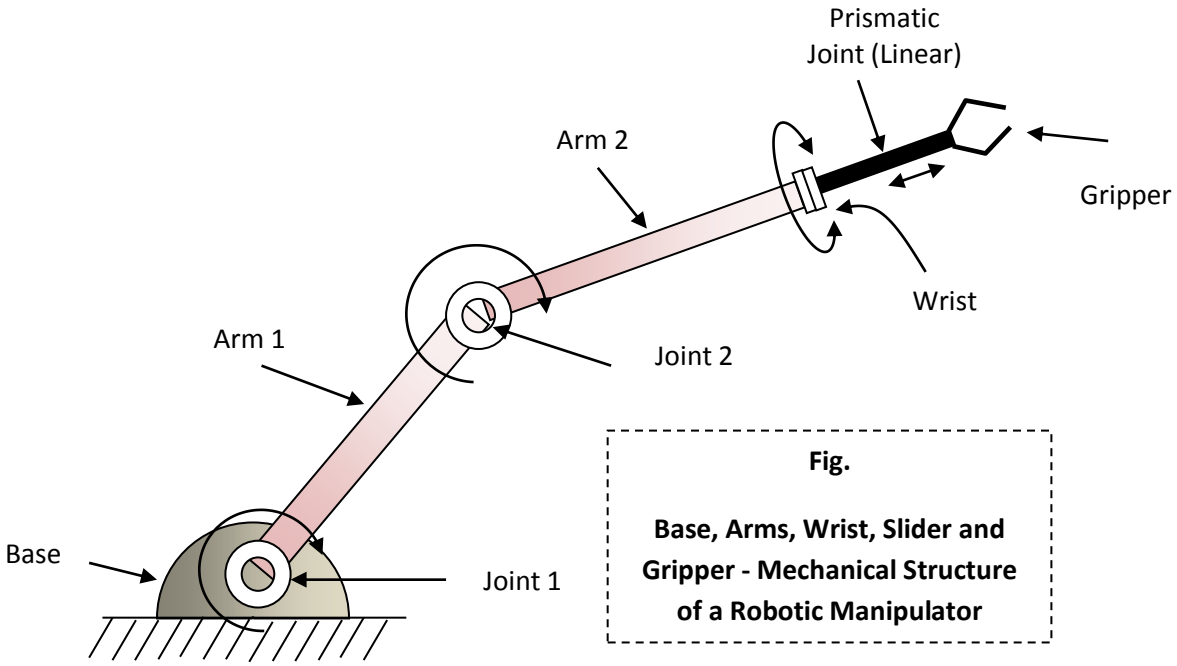
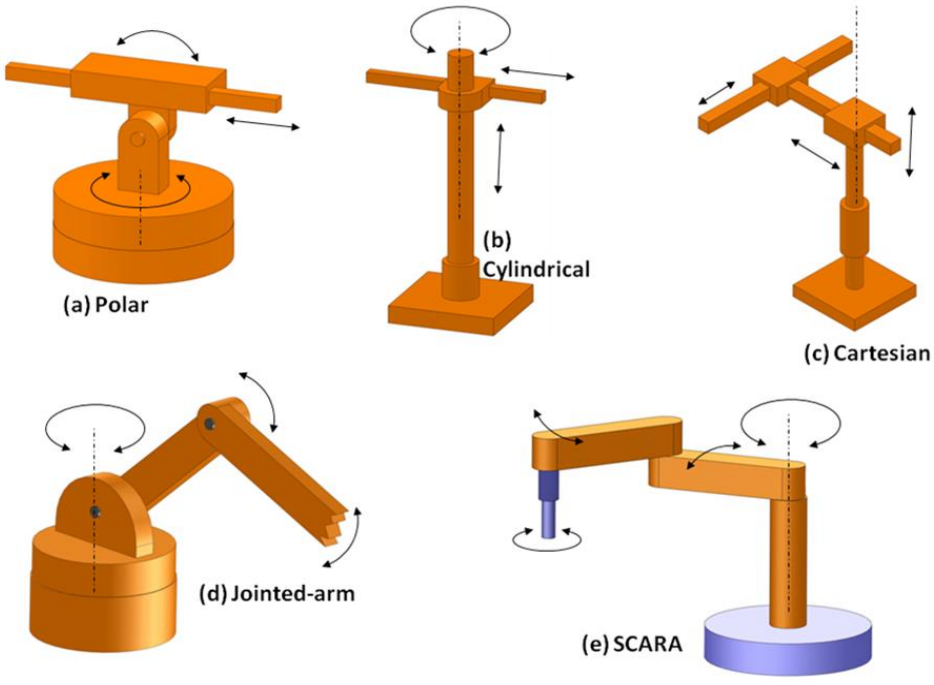


Fig.

Base, Arms, Wrist, Slider and Gripper - Mechanical Structure of a Robotic Manipulator

B) Robot Configurations –

1) Cartesian (Length, Length, Length) 2) Cylindrical (Length, Length, Angle)
3) Polar (Length, Angle, Angle) 4) Jointed Arm Robot
5) SCARA (Selective Compliance Assembly Robot Arm)



C) Systems used in End Effectors – 1) Mechanical, 2) Vacuum, 3) Magnetic etc.

D) Tools used in Industrial Robotics – 1) Welding gun, 2) Spray paint gun, 3) Spindle for drilling, 4) Screw driver, 5) Heating torch etc.

E) Actuators –

1) Electric Motors (most commonly used) – DC Motors, 1 phase / 3 phase AC Motors, Synchronous Motors, Shaded Pole Motors, BLDC Motors, Stepper Motors, AC / DC Servo Motors.
2) Pneumatic Cylinders – used in small robots – single acting, double acting.
3) Hydraulic Cylinders – used in large Robots.

F) Sensors – Introduction only -

1) Proximity sensor (Range sensor) – to understand nearness.
2) Tactile sensor (contact sensor) – to sense touch / pressure.
3) Current sensor –
4) Tilt sensor – Inclination.
5) Gyroscope – Orientation / Angular Velocity.
6) Encoders – Speed of Motor.
7) Hall effect sensor – Magnetic field.
8) Temperature sensor.
9) Acceleration sensor.
10) Image sensor, Camera etc.

G) Programming Interface –

1) Embedded C
2) Python

   Many “Proprietary” languages are also used.
3) MATLAB - MathWorks
4) RobotC – LEGO
5) KRL – KUKA
6) KAREL - Fanuc

H) Important terminology used in Robotics –

1) **Workspace** – The set of locations that can be reached by the Robot.
2) **Forward Kinematics** – Given Joint parameters determine the final location of the end effecter.
3) **Inverse Kinematics** – Given desired end effecter position and orientation, determine the Joint parameters.
4) **Dynamics** – What forces and Torque need to be applied to Joints to achieve the desired Velocities / Accelerations.
5) **Trajectory** – A path through the space at the specified Velocities.

I) Specifications of a Robot –

1) **Accuracy –** It is measure of how close the Robot reaches to the programmed point in the workspace. Nearness to the desired one is accuracy.
2) **Precision –** Being Precise may not be Accurate. This is closeness of many readings together is being Precise.
3) **Repeatability –** It is a measure of how close the Robot reaches to the point previously reached by the Robot. It is ability to do the work again and again with the same quality.
4) **Resolution –** It is the smallest movement / measurement or any other output that a Robot is capable of making.
5) **Degrees of Freedom –** DOF of a mechanical system is the number of independent parameters that define its configuration (Translational, Rotational). The number of DOF is equal to the total number of independent displacements or aspects of motion.

J) Important parts of a Robot –

1) Links – These are the rigid parts like arm of a human.
2) Joints – These permit relative motion between links like a shoulder or wrist of a human. e.g. Revolute Joint (Rotary) and Prismatic Joint (Sliding)

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3) Gripper – The gripper holds the object to be moved like the fingers.

K) Generalised Block Diagram of a Robotic System –

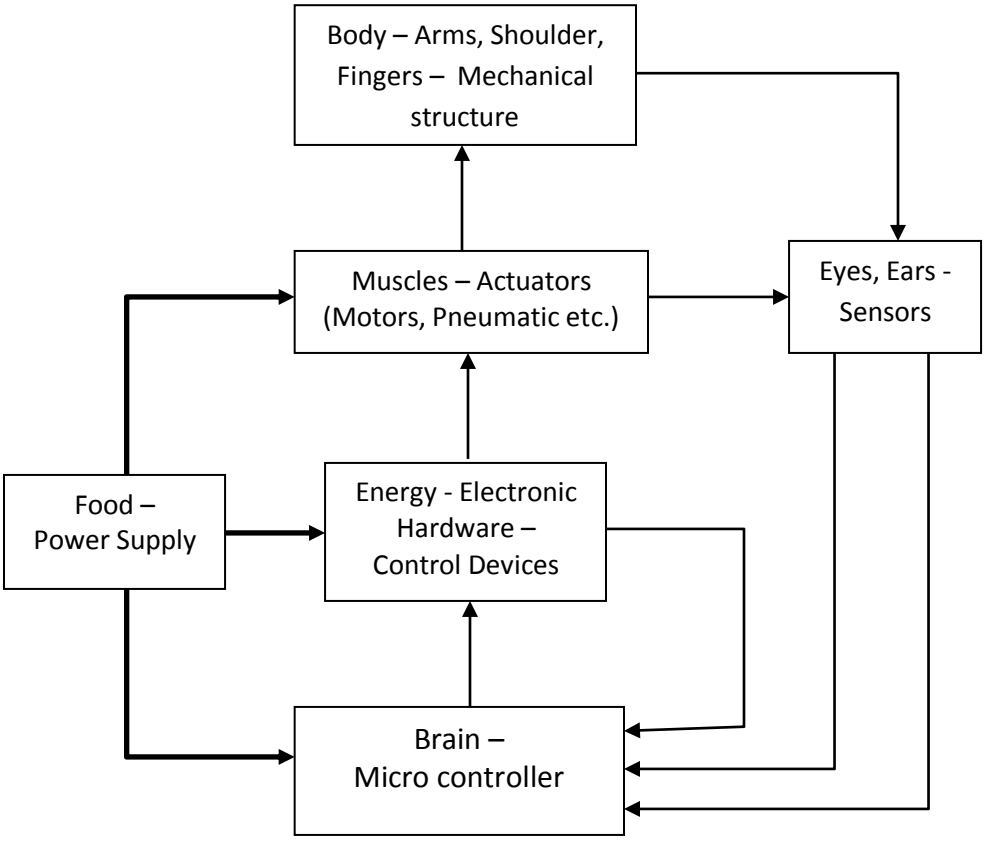

Fig.

Robot – Analogy with Human Body