Home Assignment - 1
[Resultant force and Equilibrium]

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⇒ Assignment

Question) What do you mean by the term ROBOT ? Mention Fundamental Laws.

- A ROBOT is a multifunctional, reprogrammable, manipulator (task performer) capable to perform the ordered task in an optimized manner with required accuracy, repeatability and reliability.
- It is a machine capable of carrying out a complex series of actions automatically, especially by a computer.
- ISO Definition:
  An automatically controlled, reprogrammable, multipurpose manipulator programmable in three or more axes, which can be either fixed in place or mobile for use in in industrial automation application.
- A robot is a reprogrammable, multifunctional manipulator designed to move material, parts, tools or specialized devices through variable programmed motions for the performance of a variety of tasks.

estion1) Fundametal of Laws of Robotics

ns. Following are the laws of Robotics:

First law:
A robot may not injure a human being or through inaction, allow a human being to come to harm, unless this would violate a higher-order law.

Second Law:
A robot must obey orders given to it by human beings, except where such orders would conflict with a higher order law (first law).

Third Law:
A robot must protect its own existence as long as such protection does not conflict with a higher order law (second law).

Zeroth Law:
A robot may not injure humanity or through inaction, allow humanity to come to harm.

on2) What is the difference between Automation and Robotics?

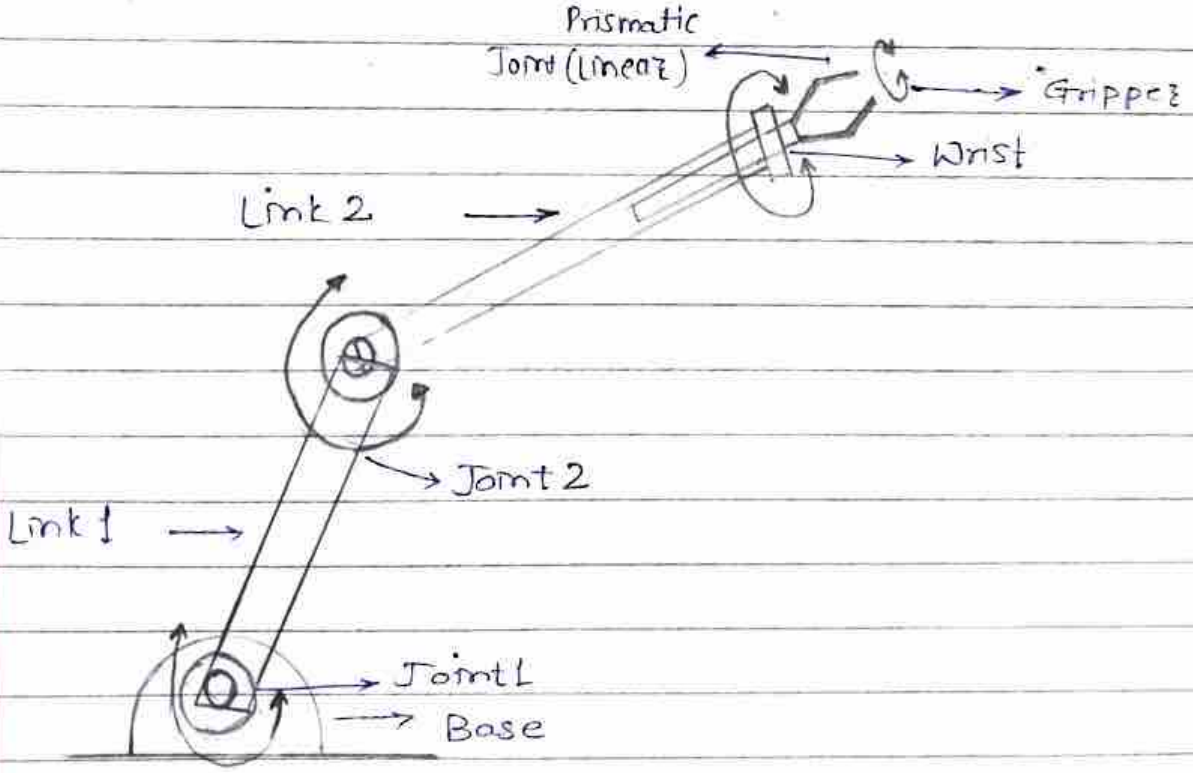
Robotics:
1) Robotics is the process of developing robots to carry out a particular function
2) Autonomous or semi autonomus information technology.
3) Conditions → Can do things and make decisions on its own. As such, robots can handle certain real world conditions without direction.
4) Robot is able to deal with wide range of inputs & conditions with direction

Automation:

1) Definition: Automation is the process of using technology to complete human tasks.
2) Work performed by information technology or machines
3) Conditions → Requires predictable conditions such as well formatted data and interchangable parts.
4) Automation takes exact inputs and create exact outputs

Question3) Explain the anatomy of a robot with a neat diagram.

Anatomy of a robot [Diagram]



Anatomy : Consists of Joints & Links

~~Ear~~

⇒ Each joint is connected to two link, an input link, and an output link. Joint provides controlled relative movement between the input link & output link.

⇒ A robot link is the rigid component of the robot manipulator

⇒ Most of the robots are mounted upon a stationary base, such as the floor. From this base, a joint-link numbering scheme may be recognized.

⇒ 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 & the input link for joint-2. This joint - link - numbering scheme is further followed for all joints & links in the robotic systems.

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Question 4) What are different joints types & robot configuration and their work space.

Joints: There are mainly two types of Joints.
1) Prismatic Joints (P)
2) Revolute Joints (R)

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 O 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 (R type joint)
In this type the joint provides rotational relative motion, with the axis of rotation perpendicular to the axes of the input and output links.

d) Twisting joint (T joint)
This joint involves rotary motion, but the axis of rotation is parallel to the axes of the two links.

e) Revolving joint (V joint)
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.

Robot Configurations and Work Space

a) Cartesian co-ordinate robot
- Also known as the rectilinear robot & x-y-z robot
- Consists of three sliding joints two of which are orthogonal O-joints

b) Cylindrical
- consists of a vertical column
- The arms can ~~m~~be moved up and down relative to vertical column.
- The arms can be moved in & out relative to axis of column
- A common configuration is to use a T-joint to rotate the column about ~~it~~ its axis
- A L-joint : to move the arm assembly vertically
- An O-joint: ~~to~~ used to achieve radial movement of the arm

c) Polar Configuration (or spherical)
- Consists of a sliding arm L-joint, actuated relative to the body, which rotates around both vertical axis (T-joint), and a horizonta axis (R-joint)

d) Jointed - arm robot (articulated)
- Consists of a vertical column that swivels about the base using a T-joint.
- Shoulder joint (R-joint) is located at the column
- The output link is an elbow joint (R-joint)

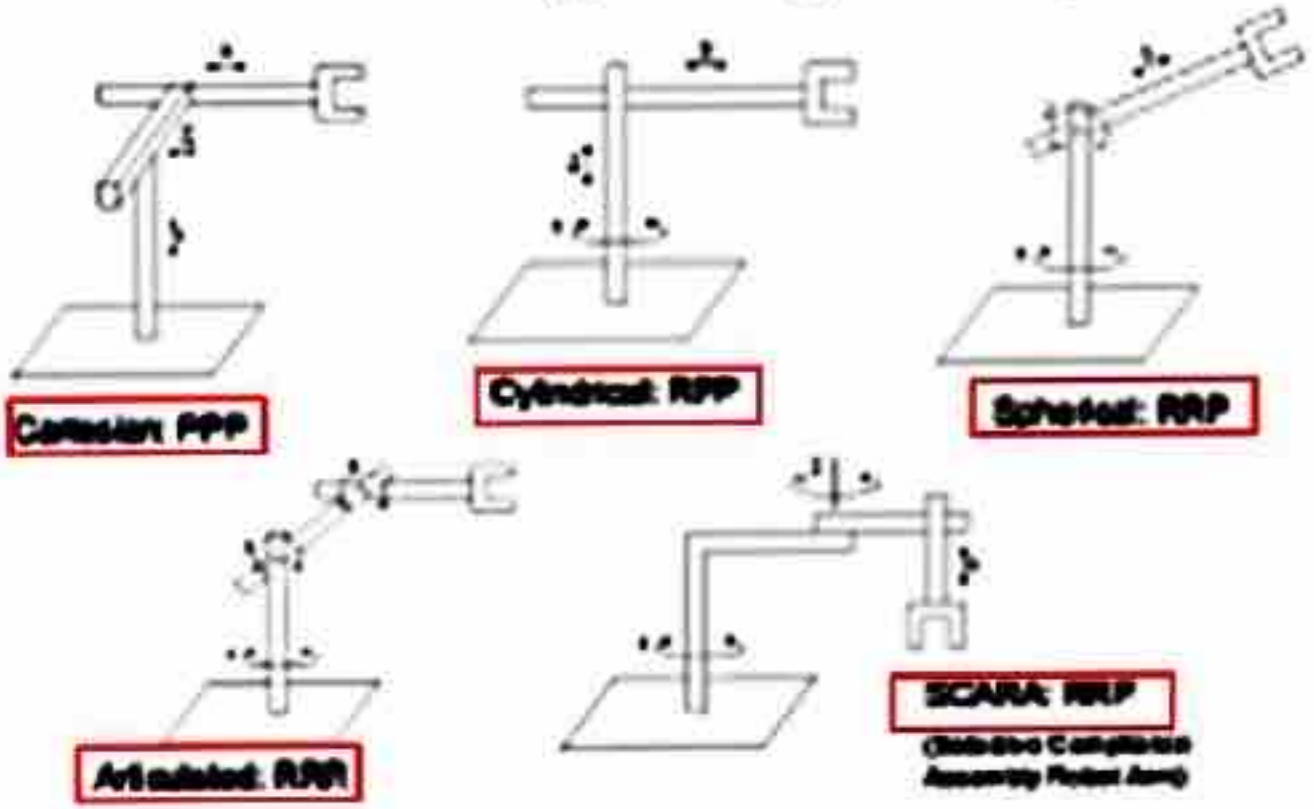
e) SCARA
- Selective Compliance Articulated Robot Arm.

ROBOT CONFIGURATION WITH JOINT TYPES

Revolute Joints (R)

Prismatic Joints (P)

Robot Configuration (geometries)



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Question 5) Explain the following terms:

1) Forward Kinematics

- It refers to the process of obtaining positions & velocity of end effector, given the known joint angles & angular velocities.
- Given the joint parameters, we can determine the final end effector location

2) Inverse Kinematice

- It refers to the process where we use kinematics equations to determine the motion of a robot to reach a desired position
- Given desired end effector position and orientation determine the joint parameters
- If the co-ordinates of the Destination Point are known, to calculate the distances (lmks) and all angles (rotation) is Inverse Kinematics

3) Dynamics (robotics)

It refers to the relationship between the forces acting on a robot and the resulting motion of the robot

4) Trajectory

A path through the space at the specified velocities

5) Degree of Freedom

It is defined as the minimum number of independent parameters / variables / co-ordinates needed to describe a system completely