Maliha Mansuri - 28

1) Explain in detail the classification of Robots.

→ Robots can be classified as:

Class 1: Manual handling device
- A device with multiple degrees of freedom actuated by an operator.

Class 2: fixed sequence Robot
- A device that performs the successive stages of a task according to a predetermined method which is difficult to modify.

Class 3: Variable Sequance Robot
- Same as class 2 but easy to modify.

Class 4 - Playback Robot
- A human operator perform the task by recording the motions for later playback. The Robot repeats the same motions according to the recorded information

class 5:- Numerical Control Robot
- The operator supplies the

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robot with a movement program rather than teaching in the task manually

Class 6 :- Intelligent Robot
- A Robot with a means to understand its environment and the ability to successfully complete a task despite changes in the surrounding conditions.

Robotics institute of America (RIA) has classified it in:

Type A : handling devices with manual control to teleRobotics

Type B : Automatic handling devices with preterminal ~~devices~~ cycles

Type C : programmable, servo controlled robots with continuous / point to point trajectories

Type D : Same as C but with the capacity to acquire information from its environment

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(2) Define the terms:-

→ Robot:-
A Robot is a machine especially designed to execute one or more tasks automatically with speed and precision.

→ Robotics:
Robotics is a branch of technology that deals with physical robots.

→ Manipulator:-
Main body of Robot which consists of links, the joints and other structural elements.

→ Robot Degree of freedom:-
Degree of freedom refers to the freedom of movement of a rigid body in three dimensional space.

→ Robot Workspace:-
Depending on the configuration and size of their links and crist joints, robots can reach a collection of points around them that constitute a Coorkspace

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(3) list the Advantages and disadvantages of Robots.

→ Advantages:-

- Robots and automation can increase productivity, effeciency, quality and consistency of product.
- Robots can work in hazardous environment such as radiation, darkness, hot/cold ocean bottoms and so on.
- Robots need no environment comfort like lighting, air conditioning, ventillation, noise etc.
- Robots are much more accurate than humans.
- Robots have repeatable precision untill they wear out.

Disadvantages:-

- Robots replace human workers, causing economic hardship, worker dissatisfication and resentment.
- Robots lack capacity to respond.
- In emergencies unless the situation is predicted and the response is included in the system,
- It is important to ensure that robots do not injure operators and other machines that are working with

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- Inappropriate / wrong responses
- lack of decision making power
- loss of power
- Damage to robots and other devices

⇒ Robots although superior in certain cases, have limited capabilities in:
- Degree of freedom and dexterity
- Real time response
- Sensors and vision systems.

⇒ Robots are costly due to
- Initial cost of equipment and installation
- Need for peripherals, training and programming.

(4) Explain in detail the components of Robot.

⇒ A Robot consist of:
- Manipulator or the rover:
  Main body of robot which consists of links, the joints and other structural elements.

- End Effector:
  The part is connected to the last joint of a manipulator that generally handles objects, makes connections

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to the other machines or performs the required tasks.

- Actuators:-

The controller sends signals to the actuators, which in turn, moves the robot joints and links.

- Sensors:-

They collect information about the internal state of robot or to communicate with the outside environment.

- Controller:-

Similar to cerebellum, it controls the motion.

- Processor:-

It calculates the motions of the robot's joints. determines how much and how fast each joint must move to achieve the desired location and speeds.

- Software:-

3 groups. (1) Operating system that operates the processor (2) Robotic software that calculates the necessary

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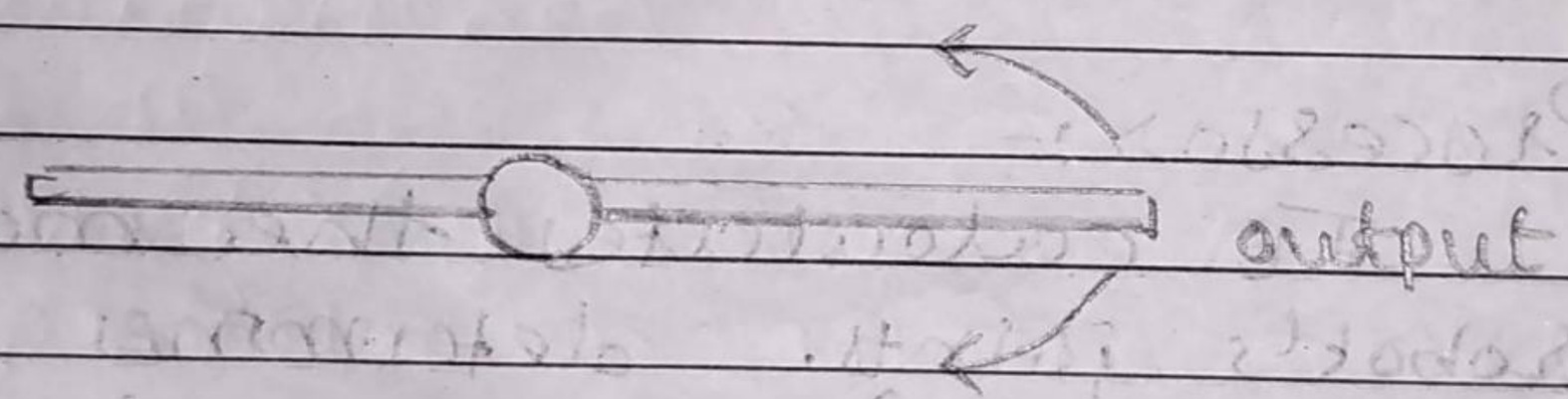
motions of each joint (3) Application oriented routines and programs.

(5) Draw and Explain Types of Robotic joints:

→ A Robot can have many different types of joints:

1. Rotational (Rotary) Joint:
This can also be represented as R-Joint
This Type will allow the joints to move in a rotary motion along the axis, which is vertical to the arm axes or perpendicular to the axes of the input and output links.



2. linear (Prismatic) joint:
This can be indicated by the letter L-Joint
This type of joint can perform both Transtational and sliding movements

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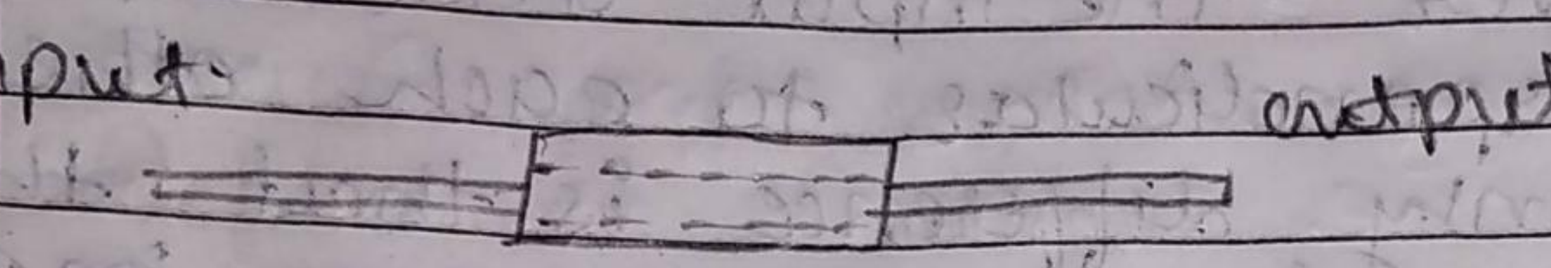
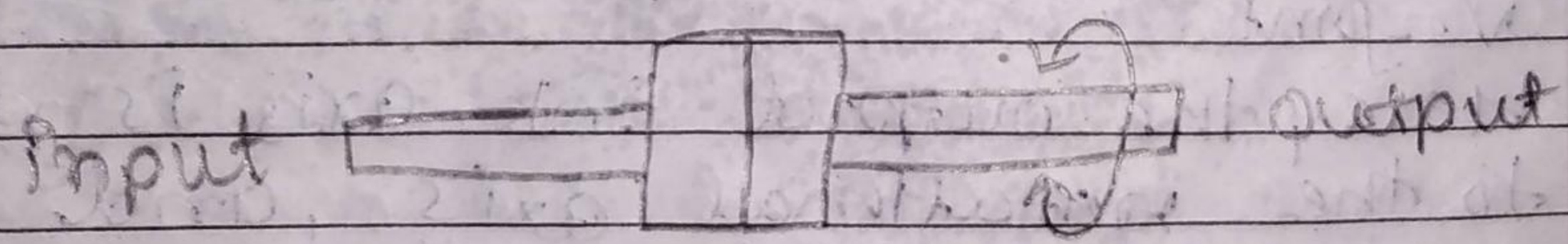
These motions will be attained by several ways such as telescoping mechanism and piston.
The two links should be in parallel axes for achieving the linear movement.



3. Twisting Joint:
Twisting joint will be reffered to as a V- Joint.
This joint makes twisting motions among the output and input link.
During this process, the output link axis will be vertical to the rotational axis.
The output link rotates in relation to the input link.



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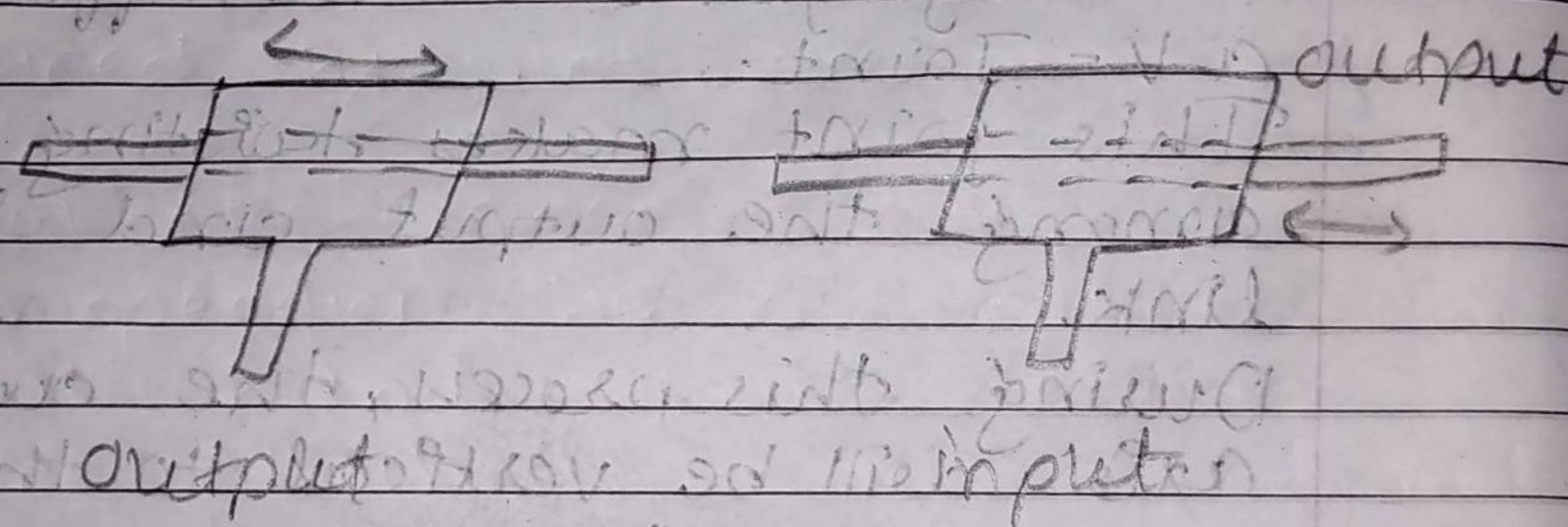
4. Orthogonal (Sliding) Joint:
The O-Joint is a symbol that is denoted for the orthogonal joint. This Joint somewhat similar to the linear joint so it provides linear motion.
However The input and output links are perpendicular to each other. The only difference is that the output links will be moving at the right angles



5. Revolving (spherical) joint:
Also provides rotational motion
Revolving joint is generally known as V-joint
Here, the output link axis is perpendicular to the rotational axis, and the input link is parallel to the rotational axes.

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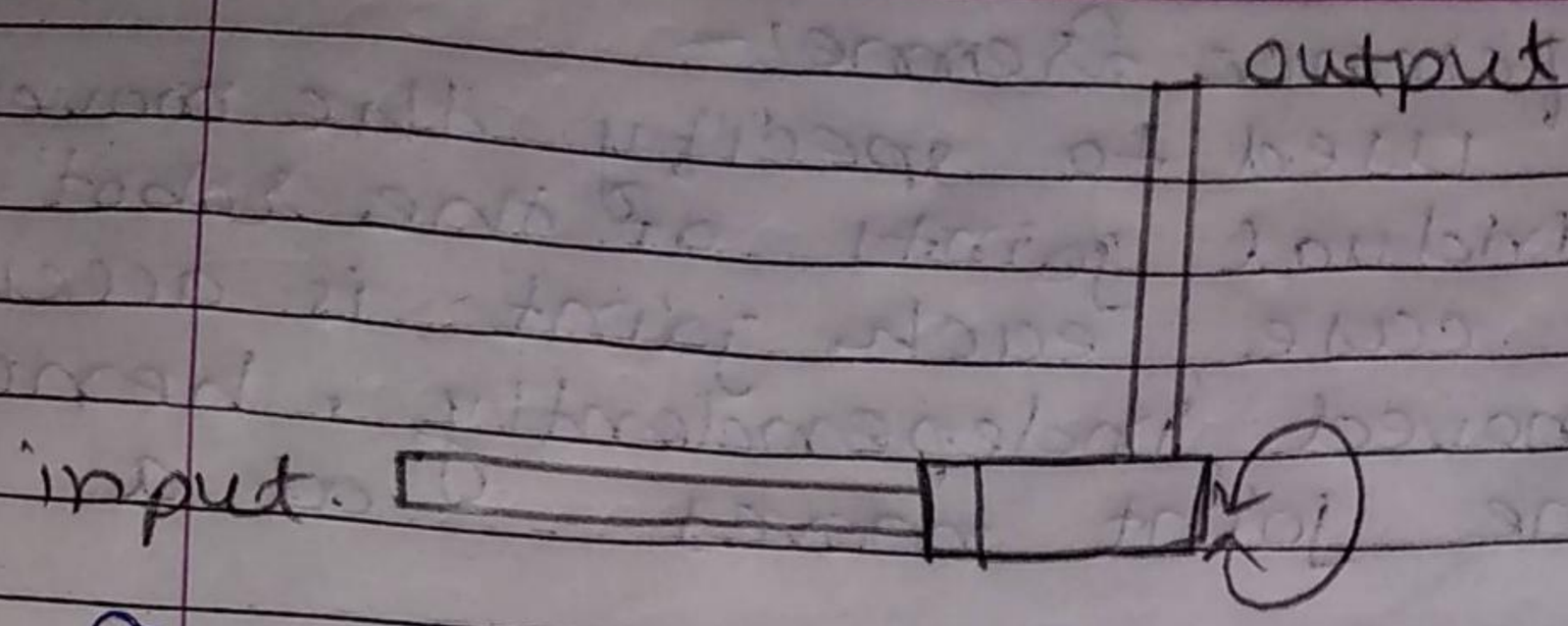

6. Draw and explain the Robot Reference frames.

- Robot may be moved relative to different coordinate frames. In each type of coordinate frame the motions will be different.

1. World Reference frame:

This is universal coordinate frame. Here joints of the robot move simultaneously, in a coordinated manner to create motions along the three major axis.

In this frame, no matter where the arm, a positive movement along the x-axes is always in the plus direction of the x-axis. Such a frame is used to define the motions of the robot relative to other objects. define other parts and machines with which the robot communicates and define motion trajectories.

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2. Joint Reference frame:-
This is used to specify the movement of individual joints of the robot. In this case, each joint is accessed and moved independently, hence only one joint moves at a time.
Depending on the type of the joint used, the motion of the robot hand will be different.
Ex:- If a revolute joint is moved, the hand will move in circle defined by joint axis.

3. Tool Reference frame:-
The specifies the movement of the robot's hand relative to the frame attached to the hand and hence all the motions are relative to this x', y', z' frame.
The local ~~and~~ tool frame moves with the Robot.
Moving the hand relative to the positive x-axis of the local tool frame will move the hand along the x-axis of the tool frame.
Hence, the tool reference frame is a moving frame that changes continuosly as the robot moves.

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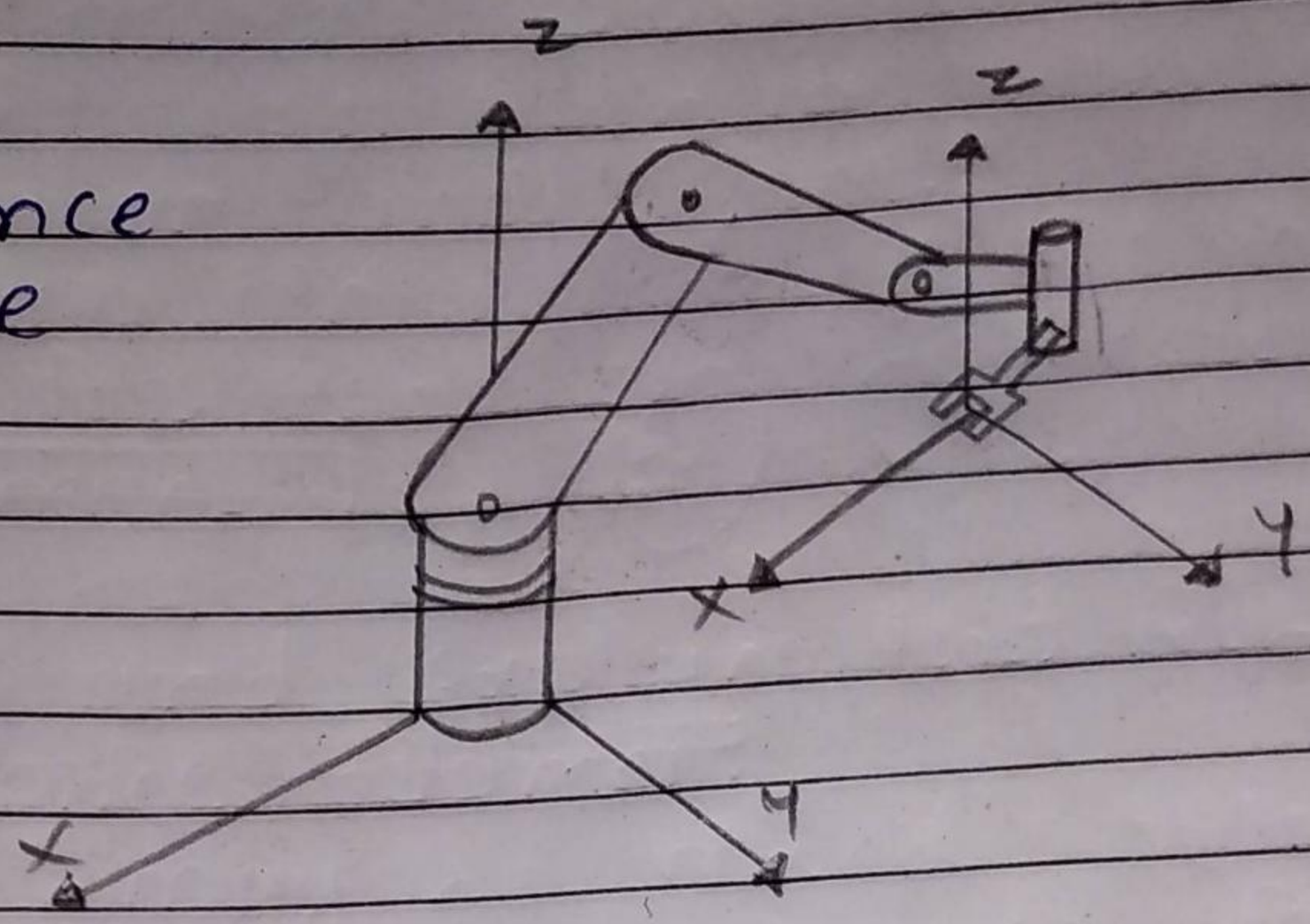
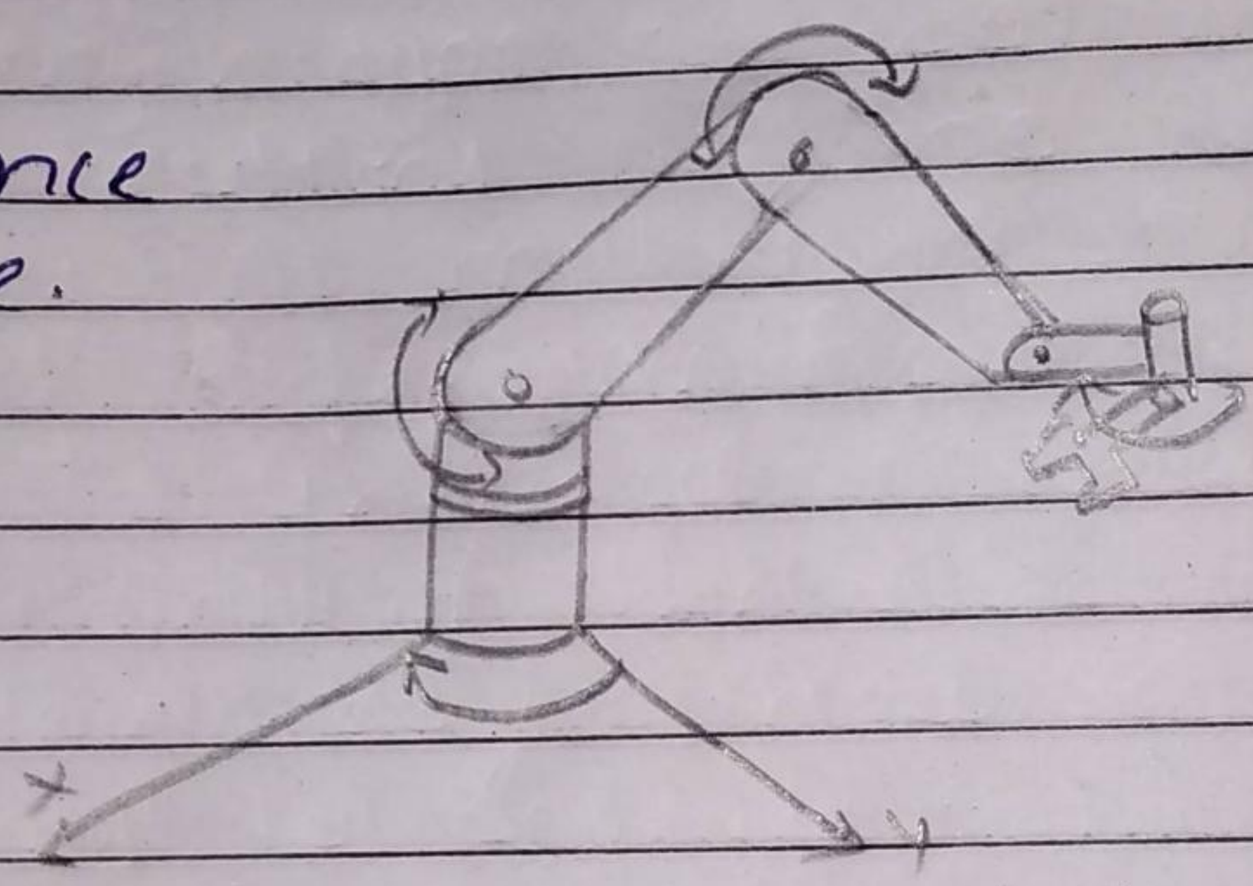
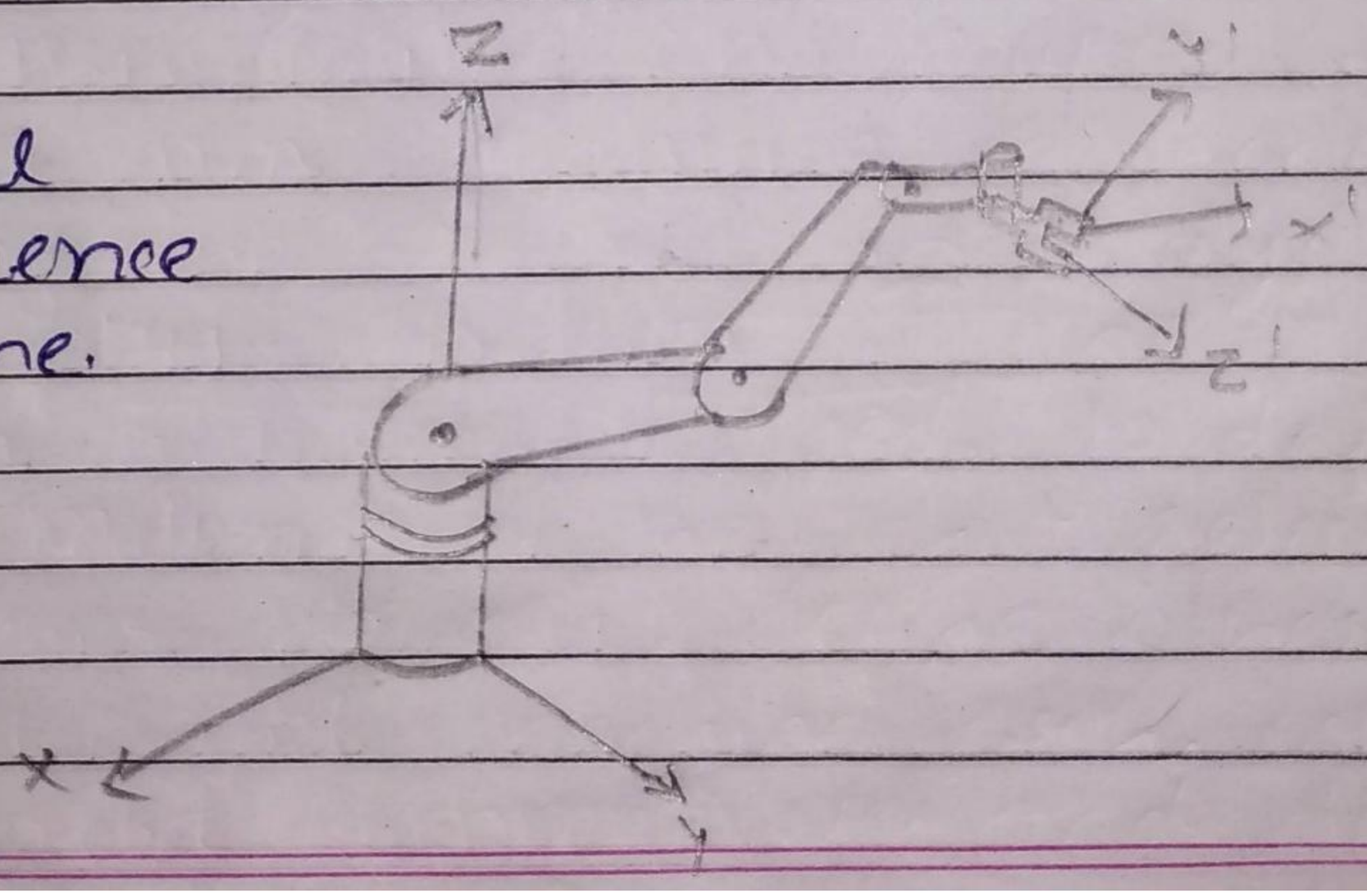
World Reference frame



Joint Reference frame.



Total Reference frame.



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