Assignment 1

Q2) 7 categories

- Manipulator
  - PUMA robot : The Puma robot is built with six joints that can bend and rotate, giving it the ability to move in six different ways. This makes it really good at mimicking human arm movements, which is useful for tasks like putting things together in factories or moving objects around.
  - Delta robot : The Delta robot features a unique design with three arms connected to a central point, resembling a spider. It's commonly used in tasks requiring fast and precise movements, like picking and placing items on assembly lines or in packaging processes. This robot type offers high-speed operations and is known for its efficiency in industries where rapid, repetitive actions are needed.
- UAV
  - PD1 fixed wing UAV : The PD1 fixed-wing UAV (Unmanned Aerial Vehicle) is a type of aircraft that doesn't have any moving parts like traditional planes. It's designed with a fixed set of wings that stay in one position. This UAV is great for tasks like aerial surveillance or mapping because it can cover large areas for an extended time, like a flying camera. Its stable design allows it to glide smoothly through the air, capturing valuable data from above.
  - PC1 multirotor type UAV : The PC1 multirotor UAV is like a flying machine with multiple spinning propellers, kind of like a helicopter. These propellers provide the power needed to lift and maneuver the UAV in different directions. This type of UAV is really good for tasks like aerial photography or inspections because it can hover in place and fly in tight spaces. Its agility and ability to stay in one spot make it useful for capturing detailed images or checking hard-to-reach places.

- Humanoid
    - Sophia : The Sophia robot is a lifelike humanoid robot that's designed to look and even talk like a human. It's equipped with advanced sensors and cameras that help it see and recognize faces, and it can also hold conversations using artificial intelligence. Sophia is often used to showcase the capabilities of AI and robotics.
    - Robonaut : Robonaut is a humanoid robot developed to work alongside astronauts in space. It has arms, hands, and legs that are designed to perform tasks like humans, making it valuable for jobs that are difficult or risky for humans to do in space. Robonaut's dexterity and ability to be remotely controlled from Earth make it a versatile tool for space exploration, maintenance, and research
- Nanobot
    - Xenobots : Xenobots are a new kind of biological robot created from frog cells. These tiny robots are designed to move around and perform simple tasks, showcasing a unique blend of biology and robotics. They're built by arranging cells in specific ways to create shapes and movements, opening possibilities for tasks like cleaning up pollution or delivering medication inside the body.
- Mobile robot
    - Handle (wheeled): Handle is a robotic research platform that features a unique combination of wheels and legs. It's designed for materials handling and warehouse logistics. With its two large wheels and a pair of robotic arms, Handle can move quickly and efficiently across different terrains, pick up and manipulate objects, and navigate through tight spaces. Its hybrid design makes it versatile for tasks that require both mobility and manipulation.
    - Spot (legged): Spot is a quadruped robot known for its agility and versatility. Resembling a mechanical dog, Spot can navigate various environments, including rough terrains and confined spaces, using its four legs. It's equipped with cameras and sensors that enable tasks like inspection, data collection, and remote operation. Spot's adaptable design has found applications in industries such as construction, agriculture, and research, where its mobility and ability to carry payloads make it a reliable and adaptable robotic platform.
- Tendon driven (soft robots)
    - AmphiBot: The AmphiBot project seeks to construct a biologically inspired amphibious robot, drawing from snake and fish locomotion like lampreys. This endeavor encompasses three main objectives: crafting an adaptable outdoor robot, testing new adaptive controllers

rooted in central pattern generators, and probing neural network-based locomotion mechanisms in real animals. Utilizing central pattern generator models informed by lamprey studies, the project's latest iteration, Amphibot III, achieves human-comparable swimming speeds.

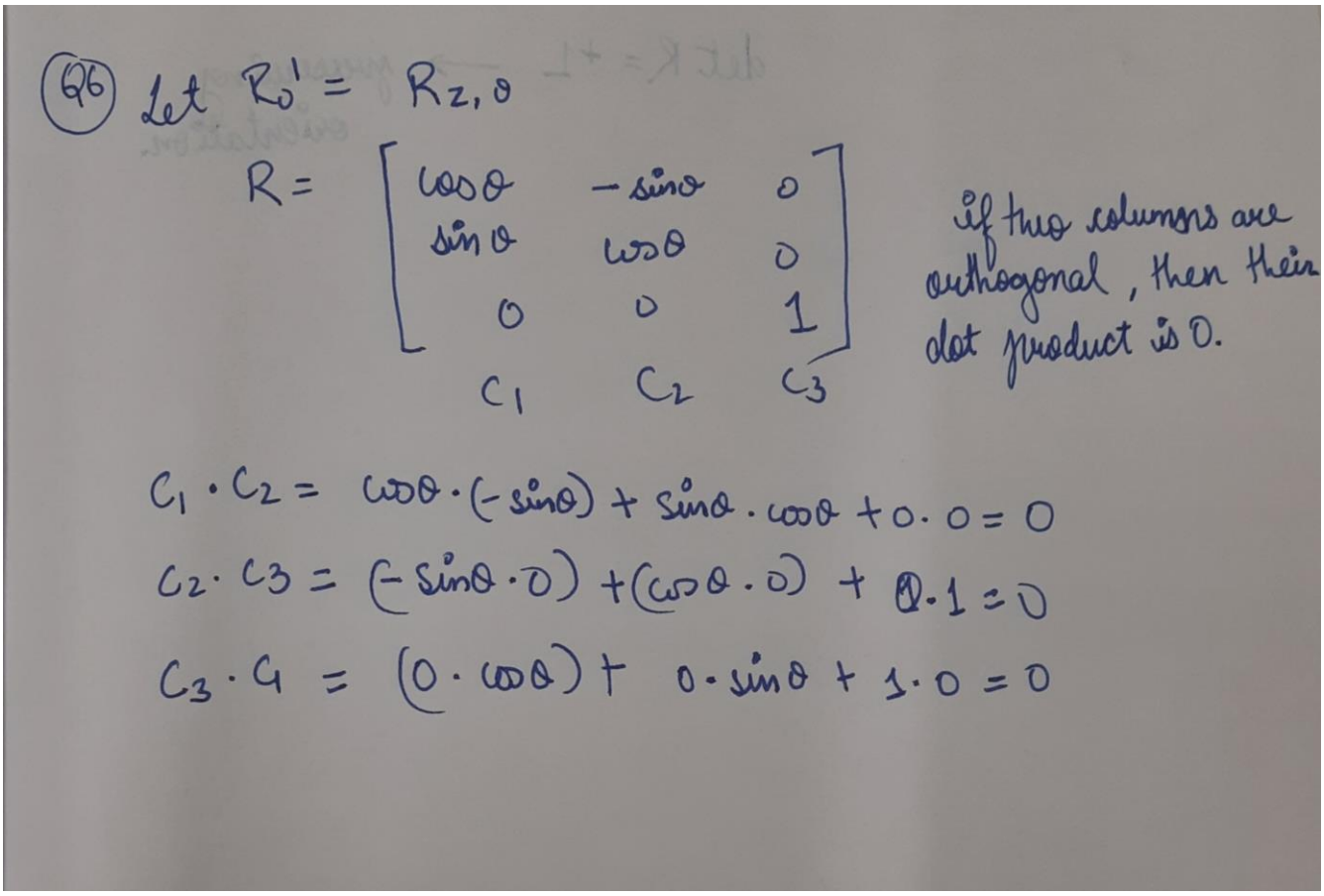
    - COAST Guidewire Robot : The Coast Guidewire Robot is a specialized robotic system developed for medical procedures, particularly in the field of cardiology. This robotic platform is designed to navigate and manipulate guidewires during minimally invasive interventions like angioplasty. By providing precise control and enhanced maneuverability, the Coast guidewire robot assists doctors in threading guidewires through blood vessels with high accuracy. This technology aims to improve the safety and success of procedures, reducing the risks associated with complex cardiovascular treatments.
- Underwater Autonomous vehicles
    - Neerakshi : The AUV is designed for underwater exploration and surveillance.
    - Integra :
    - The Aquabotix Integra Hybrid AUV/ROV transforms underwater tasks by combining AUV and ROV capabilities. It navigates large areas as an AUV and inspects closely in ROV mode by attaching a tether for control.

Q3) Common types of motors:

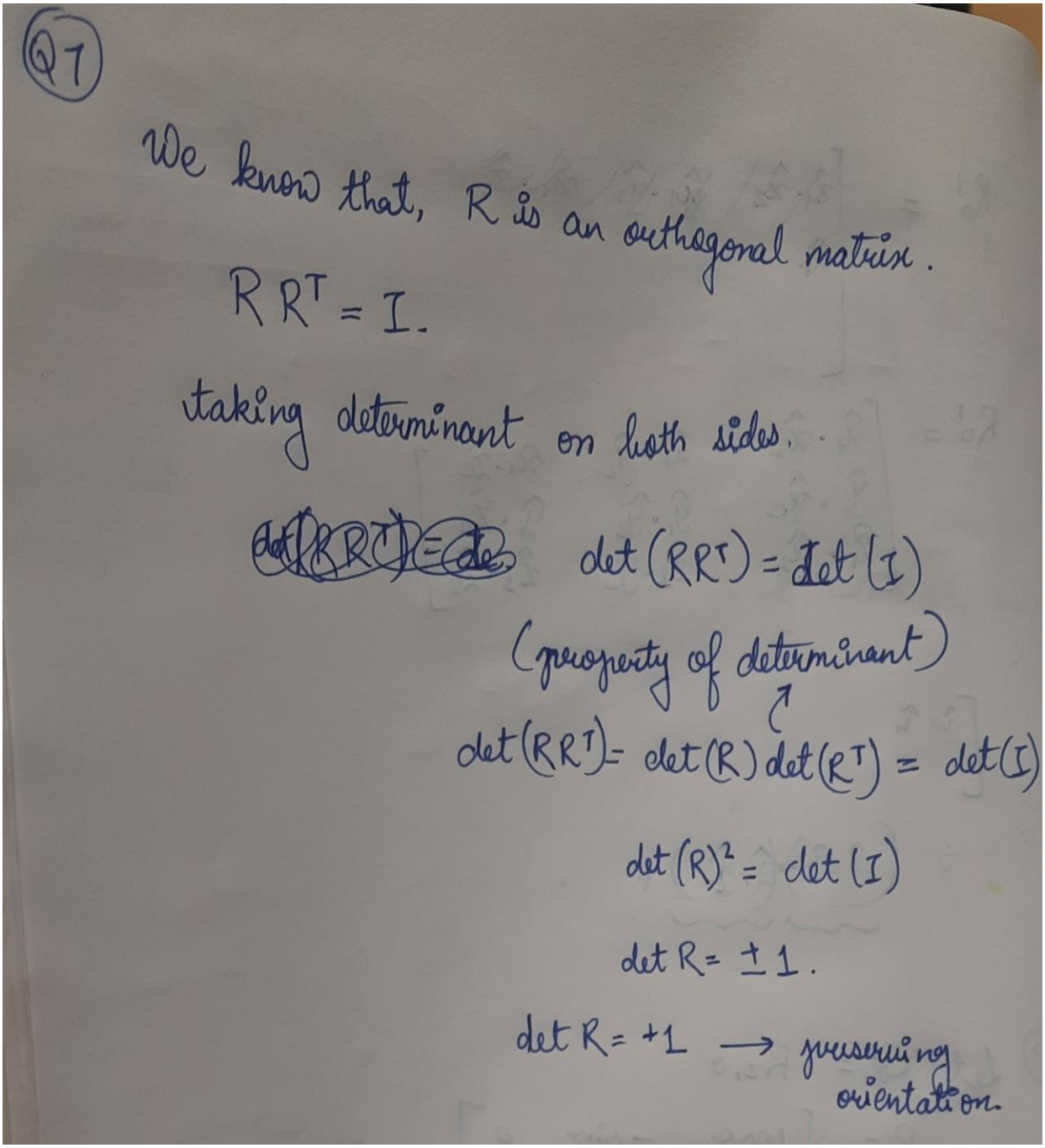
- DC Motor: These motors run on direct current and are known for their simple construction and control.
- AC Motor: Alternating current motors are widely used for their efficiency in converting electrical energy into mechanical motion.
- Synchronous motor: These motors support a synchronized speed with the AC power supply frequency, resulting in consistent performance.
- Brushless motor: Brushless motors offer greater efficiency and reliability by eliminating the need for brushes, which can wear out over time.
- Brushed motor: These motors use brushes to conduct current to the rotor, making them simpler but potentially less efficient and more prone to wear.
- Stepper motor: Stepper motors move in discrete steps, allowing for precise control and positioning, commonly used in robotics and automation.

- Servo motor: Servo motors provide accurate control over angular or linear position, velocity, and acceleration, making them ideal for robotics and CNC machinery.

Q6)



Q7)


Q7
We know that, R is an orthogonal matrix.
$RR^T = I$.
taking determinant on both sides.
$\det(RR^T) = \det(I)$
(property of determinant)
$\det(RR^T) = \det(R)\det(R^T) = \det(I)$
$\det(R)^2 = \det(I)$
$\det R = \pm 1$.
$\det R = +1 \longrightarrow$ preserving orientation.