ENGINEERING DRAWING

(ME-109)

DE-47 Mechatronics Engineering

Syndicate –C

Project Report

Sunday 21st December 2025.

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Contents

Project

Introduction:

This robotic arm is a multi-joint mechanical manipulator designed to replicate the motion and functionality of a human arm. It consists of a fixed base, rotational joints, rigid links, and a gripper acting as the end effector. The arm's joints allow controlled movement in different directions, enabling precise positioning and orientation of objects. Each link transmits motion and force from the base to the end effector, ensuring smooth and coordinated operation. Such robotic arms are commonly modelled and analysed using CAD tools for design, simulation, and kinematic studies.

Application:

This robotic arm can be used in industrial automation for pick-and-place tasks and light assembly operations. It is suitable for educational and research purposes to demonstrate robotic kinematics, joints, and degrees of freedom. The arm can also be applied in laboratories for handling small components where accuracy and repeatability are required.

Working Principle:

The robotic arm functions by using rotational joints to move its links in a coordinated manner, allowing the end effector to reach desired positions. Motors at each joint provide controlled motion, while the rigid links transmit torque and maintain structural stability. The gripper at the end effector opens and closes to grasp, hold, and release objects with precision.

Parts:

1. **End Effector:**

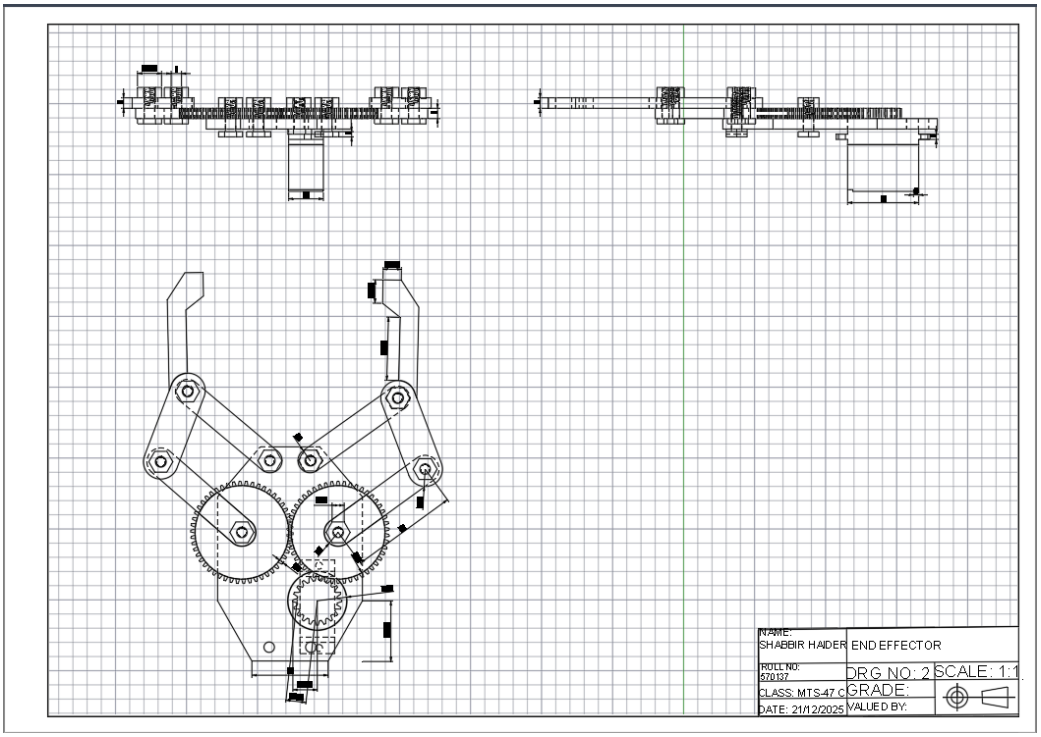

Figure 1: END EFFECTOR (Orthographic Projection)

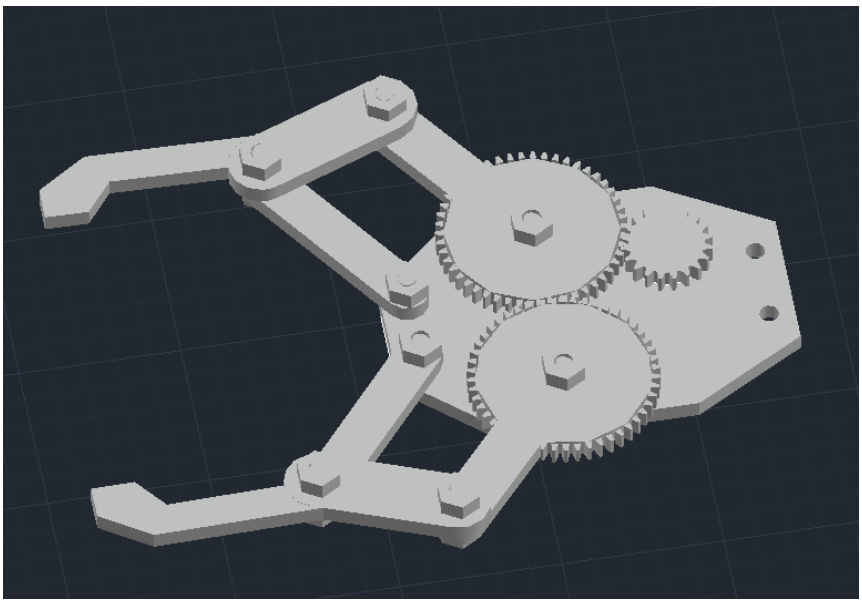

Figure 2: END EFFECTOR (3D MODEL)

Construction: The end effector was constructed using basic 2D sketches of the gripper profile, followed by the EXTRUDE command to create 3D geometry. FILLET and CHAMFER were applied to smooth edges and corners. Multiple parts were aligned using MOVE and UNION operations.

2. Wrist:

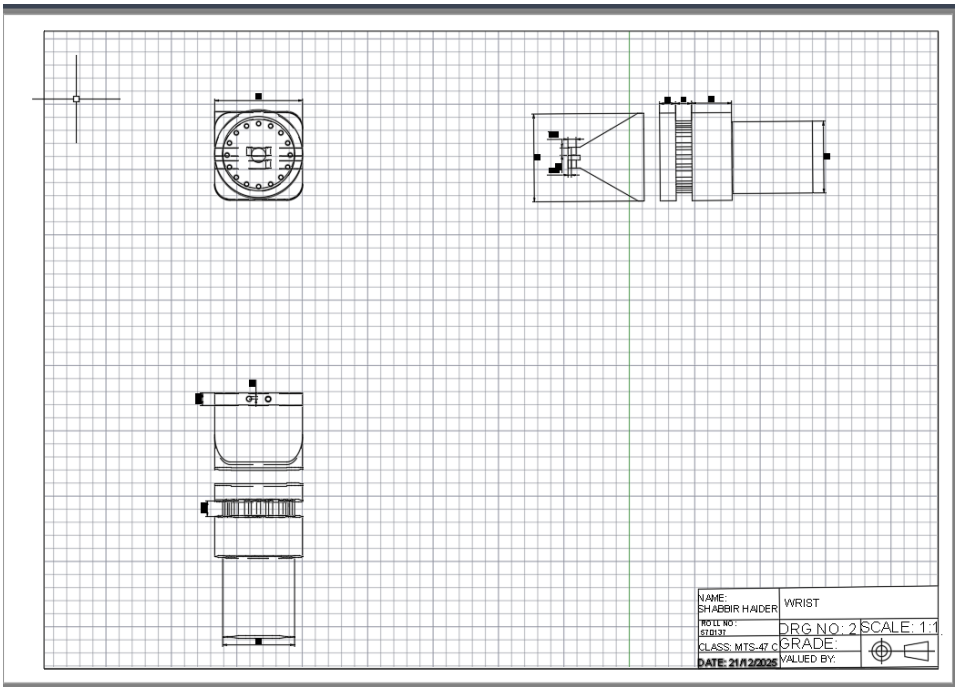

Figure 2: WRIST (Orthographic Projection)

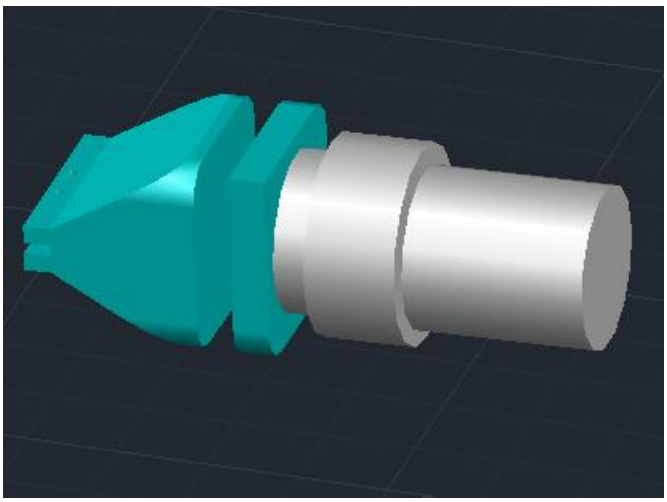

Figure 2: WRIST (3D MODEL)

Construction: The wrist component was created by drawing circular profiles and applying the REVOLVE command to form a cylindrical joint. SUBTRACT was used to create internal clearances for rotation. The wrist was positioned accurately using ALIGN with adjacent parts.

3. Bolt:

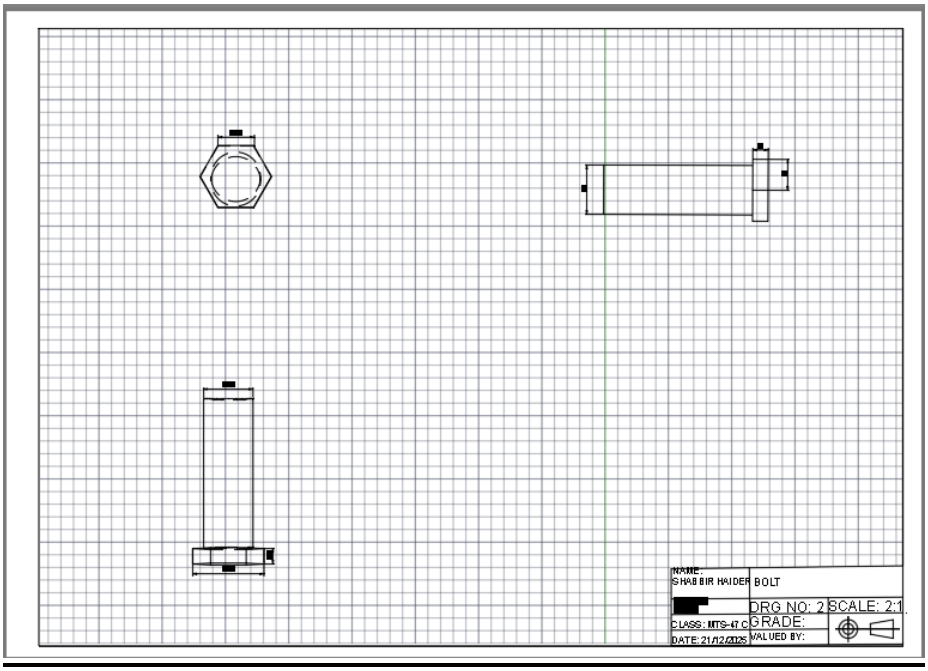

Figure 3: Bolt (Orthographic Projection)

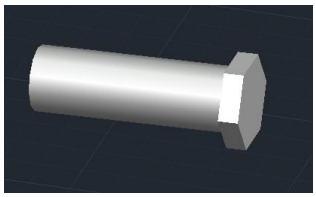

Figure 2: Bolt (3D Model)

Construction: The bolt was modeled using a circular sketch extruded with the EXTRUDE command. Threads were represented using HELIX and SWEEP (or simplified for modeling). The bolt head was refined using FILLET for realistic edges.

4. Elbow:

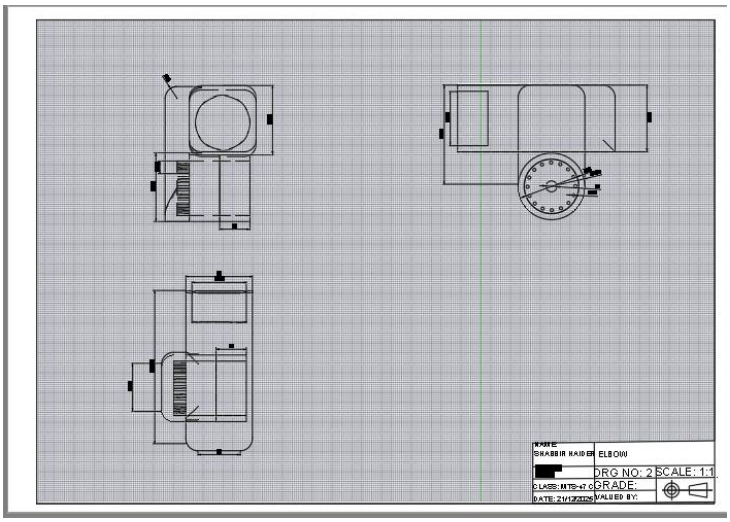

Figure 4: Elbow (Orthographic Projection)

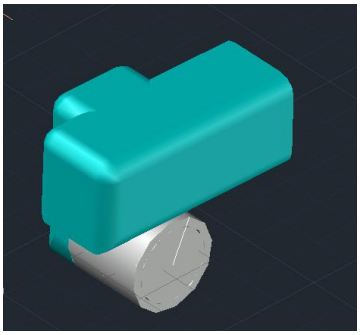

Figure 2: Elbow (3D Model)

Construction: The elbow joint was designed using combined EXTRUDE and REVOLVE operations for both housing and joint rotation. Holes were created using SUBTRACT for bolt insertion. Proper joint alignment was ensured using OSNAP and ALIGN tools.

5. Upper Arm Link:

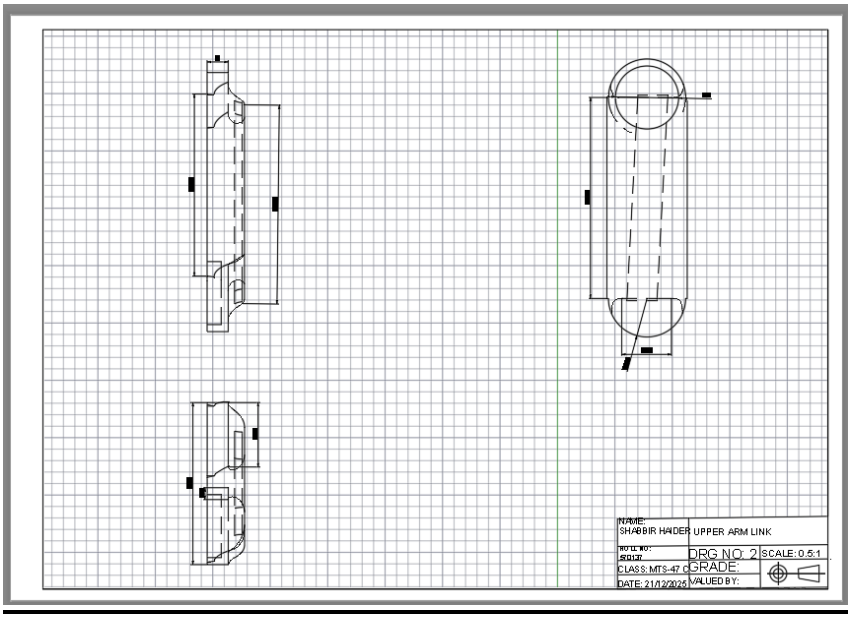

Figure 5: Upper Arm Link (Orthographic Projection)

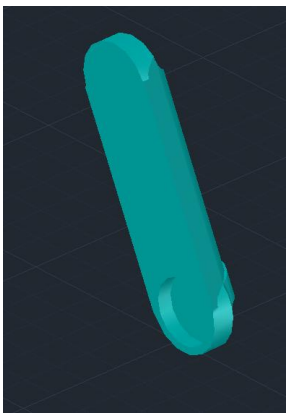

Figure 2: Upper Arm Link (3D Model)

Construction: The upper arm link was constructed by sketching a rectangular and cylindrical profile and applying EXTRUDE. FILLET was used to remove sharp edges for strength and aesthetics. Boolean operations like UNION were applied to merge multiple solids

6. Shoulder:

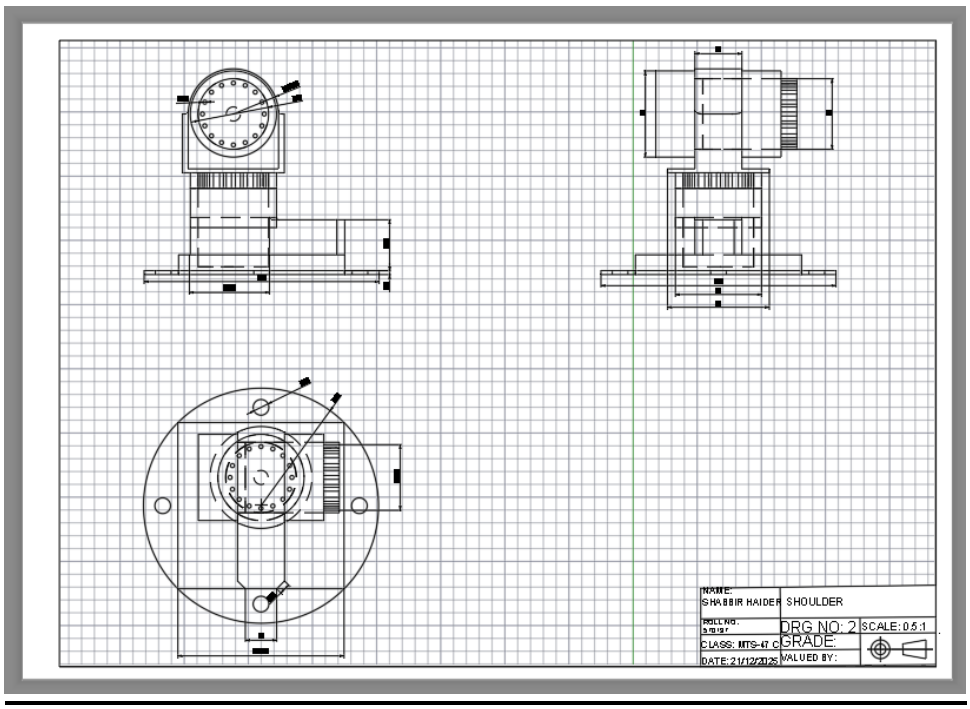

Figure 6: Shoulder (Orthographic Projection)

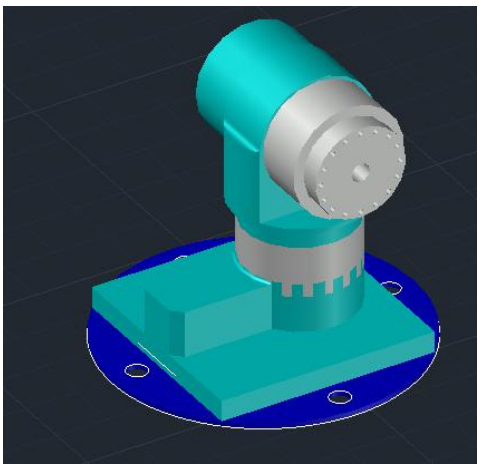

Figure 2: Shoulder (3D Model)

Construction: The shoulder was modeled using a circular base profile with the REVOLVE command to allow rotational motion. Mounting holes were created using SUBTRACT after extruding circles. The shoulder assembly was placed on the base using MOVE and ROTATE tools.

Final Assembly:

Robotic Arm 3D model:

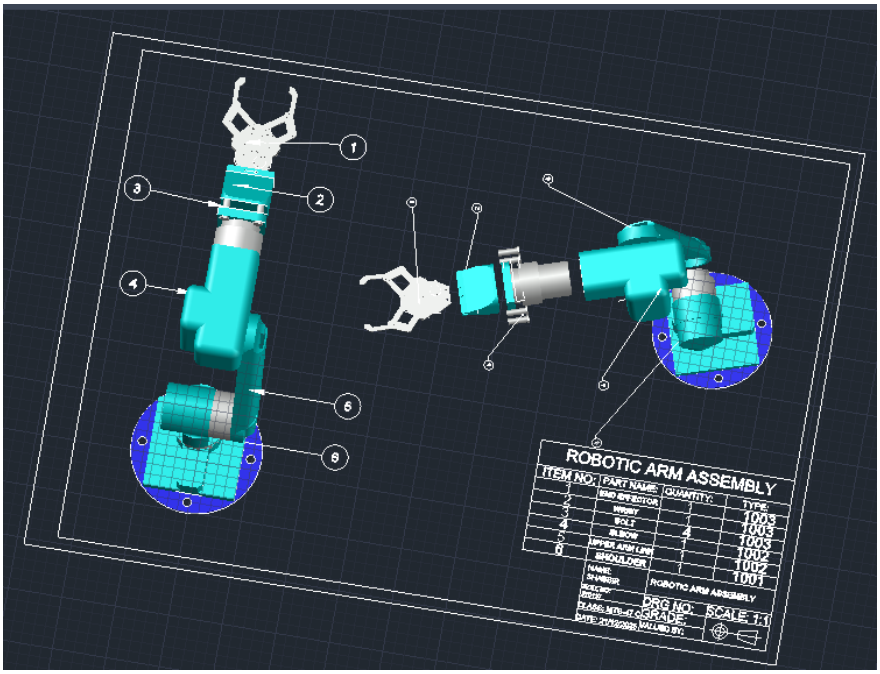

Figure 7: Assembled Drawing on the left, Exploded View of the Assembled Drawing on top right side and drawing table on the bottom right

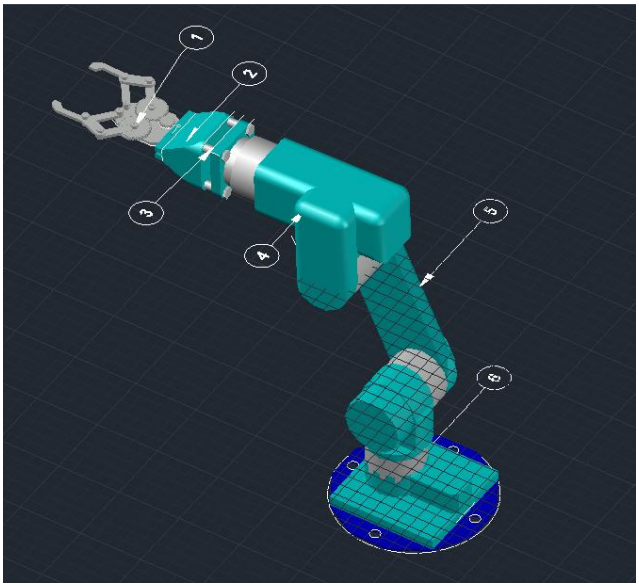

Figure 2: Final Assembled Drawing of Robotic Arm

Conclusion:

In conclusion, this robotic arm demonstrates the fundamental principles of robotic design, including joints, links, and controlled motion. Its structure enables accurate positioning and manipulation of objects in a defined workspace. The model highlights the importance of coordination between mechanical components and actuators for smooth operation. Such robotic arms play a vital role in automation, education, and research applications. Overall, it provides an effective representation of how modern robotic systems function in real-world scenarios.