Problem Statement (Mechanical Engineering Track)

Task

Design a realistic, fully functional robotic arm in the CAD software of your choice. The arm must be capable of performing the following operations with practical feasibility and appropriate mechanical articulation:

1. Pick and Carry:
   Lift and transport a cache with the following characteristics:
   - Handle length: minimum 10 cm
   - Handle diameter: maximum 5 cm
   - Weight: less than 2 kg
2. Drawer Operation:
   Open a drawer, place the cache inside, and close the drawer.
3. Control Interaction:
   - Press buttons
   - Flip toggle switches
   - Rotate knobs
   - Operate a joystick
4. Mechanical Interactions:
   - Undo latches
   - Open access panels
5. Electrical Task:
   Insert a standard three-pin plug into a standard three-pin socket.

All components may be:

- Commercial off-the-shelf, or
- Custom-fabricated (CNC, Laser, Milling, etc.), in which case you must specify the fabrication method and justify it.

Material selection for every component must include the reason for choosing that material. Motor selection must include torque calculations and will be evaluated thoroughly.

Specifications

- Reach: 1 meter
- Payload: 2 kg at full 1 m extension
- Voltage: 24V

Deliverables

You must upload the following:

1. CAD Model
    - File format: .stp
    - Place a 1 m x 1 m x 1 m reference cube next to the model.
2. Video Demonstration
    - Show the CAD model from all major angles.
3. Bill of Materials (BOM)
    - Include component links (COTS or fabrication details).
4. Motor Selection Calculations
    - Show all torque calculations and assumptions.
5. Free Body Diagram & Analysis
    - Provide all relevant FBDs and mechanical reasoning.