

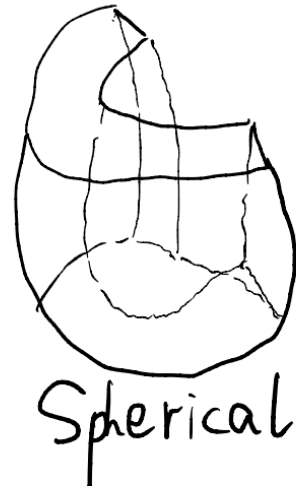
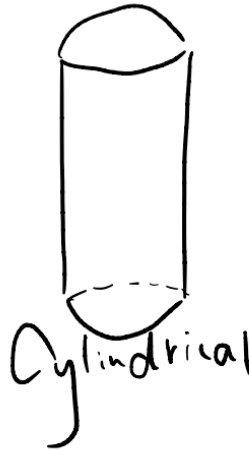
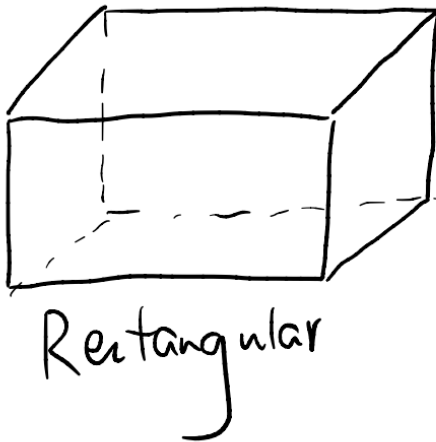
20MECH5131/6031 Intro to Robotics
Homework#3 - Robot Geometry and Configurations (80 pts)

Student Name: Hongui Yi Score: _____

Answer the following questions and submit your work in a SINGLE file online by due date/time.

1. Answer:

- (a) Cartesian Polar Jointed-arm (Articulating Configuration)
- (b)

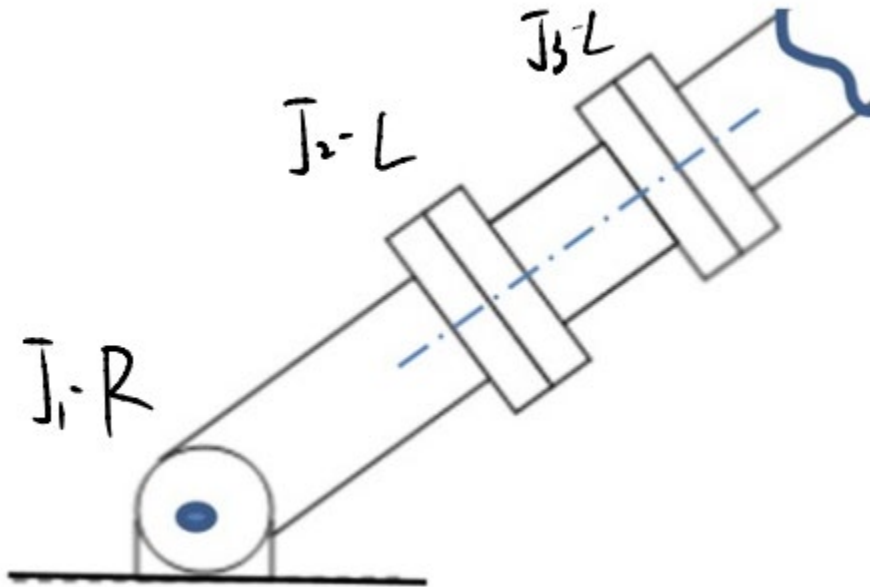


2. Answer:

- (a) Robot manipulator is a mechanical arm
- (b) Body-and-arm & Wrist assembly
- (c) Body-and-arm: for positioning of objects in the robot's work volume
Wrist assembly: for orientation of objects

3. Answer:

- (a) The number of ways of a robot can move, or motions of robot parts. The motion can be of a pivoting nature or a reciprocal motion.
- (b) No
- (c) DOF:2 Joints:3



4. Answer:

- (a) To achieve flexibility, such as obstacle avoidance in the workplace, parts assembly and machining applications.
- (b) Limited flexibility
- (c)

5. Answer:

- (a) The envelope or space within which the robot can manipulate the end of its wrist
- (b) The shape of the work envelope depends on the robot's configurations, such as
 - i) Polar configurations robot tends to have a partial sphere
 - ii) Cylindrical robot has a cylindrical work envelope
 - iii) Cartesian coordinate robot has a rectangular work volume
- (c) These factors determine the size of a robot's work envelope:
 - i) The number and types of joints, and the physical sizes of the links
 - ii) The ranges of the various joints, and the physical sizes of the links

6. Answer:

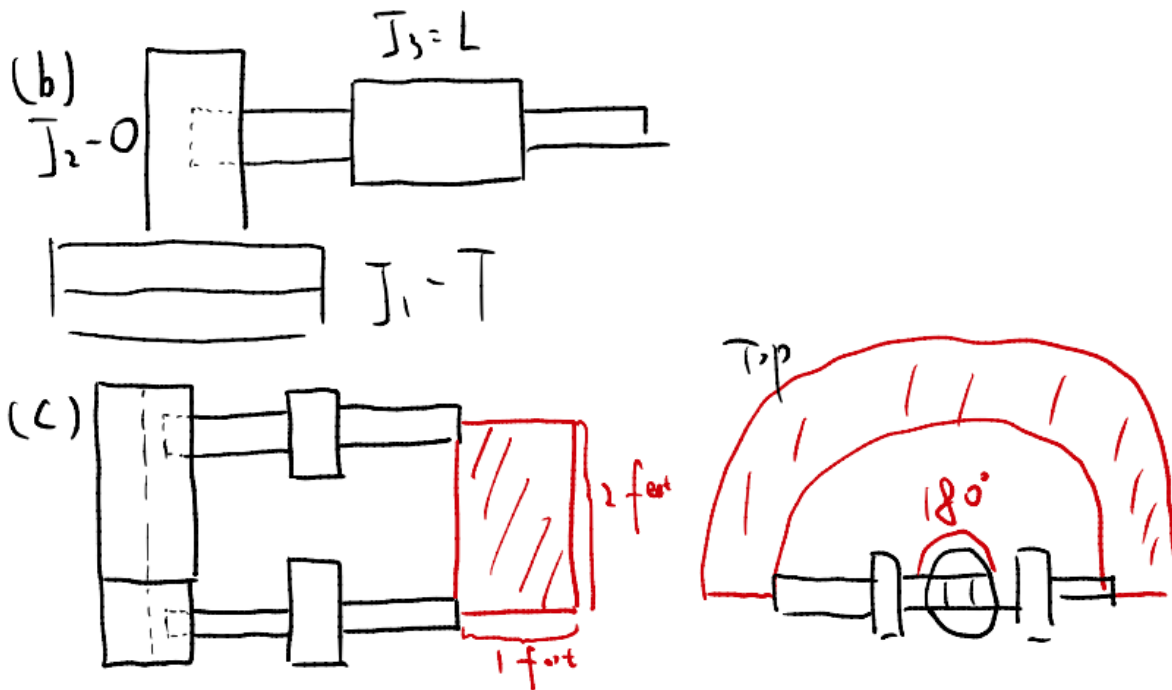
- (a) Advantages:
 - i) Although it occupies a minimum of floor space, the robot achieves deep horizontal reach
 - ii) A good size-to-reach ratio is achieved, a result of the arm's ability to fold up when in the retracted position
 - iii) Can be mounted on a slide to increase the mobility and expand the work envelope
- Disadvantages:
 - i) Sophisticated servo controllers required straight-line motion along X, Y, or Z requires the coordinated movement of three joints
 - ii) High cost
 - iii) Complex kinematics
- (b) Such as welding, because welding is a very complex job that requires a robotic arm like a human hand to complete and articulating configuration works like a human arm, base rotates similar to a twisting human torso. Shoulder and elbow usually pivot on one axis.

7. Answer:

- (a) Selective Compliance Articulating Robot Arm
- (b) It is commonly used for assembly. This is because SCARA robot can move freely in horizontal direction but rigidly in vertical direction.
- (c) It's like a hollow cylinder. From top orientation, because the first two joints are revolving joint, it looks like a ring. From side orientation, because the last joint is linear, it looks like a rectangular. Thus, the 3D shape is like a hollow cylinder.

8. Answer:

- (a) Cylindrical configuration
- (b)&(c)



- (d) It is a semi-hollow cylinder, 2 feet high and 1 foot thick