- Upload a scanned PDF to Gradescope
- Show all work and/or computer code used in your calculations

1. An RRRP SCARA robot, which is popular for pick-and-place operations, is shown below is in its zero position.

   a) Determine the end-effector zero position configuration M, the screw axes S_i in $\{0\}$, and the screw axes B_i in $\{b\}$.
   b) For $l_o = l_1 = l_2 = 1$ and the joint variables $\theta = (0, \pi/2, -\pi/2, 1)$, write a program in the language of your choice (e.g. Matlab, Python) that calculates the end-effector configuration $T \in SE(3)$. Show that your answers using both sets of screw axes agree with each other. Include your code and the program output in your submission.
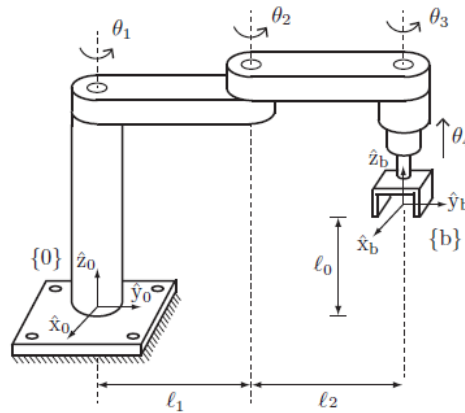
2. The RRP robot shown below is in its zero position.

   a) Write down the screw axes in the space frame. Evaluate the forward kinematics when $\theta = (90^o, 90^o, 1)$. Obtain the space Jacobian J_s for this configuration.
   b) Write down the screw axes in the end-effector body frame. Evaluate the forward kinematics when $\theta = (90^o, 90^o, 1)$ and confirm that you get the same result as in part a). Obtain the body Jacobian J_b for this configuration.
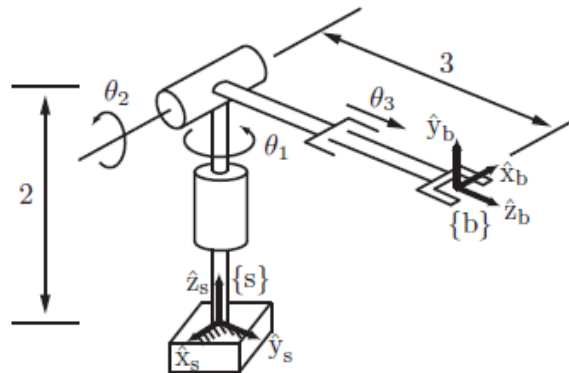
3. List the members of your group project.