MEE5114 Spring 2023 **Homework # 4**
Assigned March 27th, 2023 Due: April 2nd, 2023

This homework is to get you familiar with Drake and practice the PoE and velocity kinematics theory taught in class. Depending on your background, you may want to watch the video tutorial on Drake (see from class website).

Let us consider the robot shown in Fig.4.3 of Modern Robotics

1. Use Drake to build this robot model (similar to the example we discussed during class) and show the snapshots of the Meshcat visualization at three different sets of joint positions.
2. Write your own forward kinematics function (using PoE) to compute the pose of the end-effector frame (i.e. frame $\{3\}$) relative to the world frame $\{0\}$. Test your function for a few different sets of joint positions and compare your results with Drake's built-in function
3. Write your own function to compute the geometric Jacobian of the end-effector frame (i.e. frame $\{3\}$) expressed in the world frame $\{0\}$. Test your function for a few different sets of joint positions and compare your results with Drake's built-in function
4. Let q be a point attached to frame $\{3\}$ with local coordinate ${}^3q = (1, 2, 3)$.
   - Derive the (analytic) Jacobian ${}^0J_a(\theta)$, i.e., ${}^0\dot{q} = {}^0J_a(\theta)\dot{\theta}$. Show all your steps.
   - Write a function in Drake to implement your formula. Test your function for a few different sets of joint positions/joint velocities, and compare your results with the Drake's built-in function.