

## ME 115(a): Homework #5

(Due Friday, Mar. 4, 2016)

**Problem #1:** (10 points) Consider the simple manipulators that are associated with Prob.3 (Figure 3.23) in Chapter 3 of the MLS text. Determine the Denavit-Hartenberg parameters for manipulators (i), (ii), and (iv).

**Problem #2:** (30 points) Consider the simple “Stanford Manipulator,” seen in Figure 3.23 (iv) or Figure 3.24 (iii) of the MLS text.

- Find the forward kinematics of the first 3 joints (i.e., manipulator (iv) in Figure 3.23) using the Denavit-Hartenberg approach.
- Find the forward kinematics for the same mechanism using the Product-of-Exponentials approach.
- Find the inverse kinematics of this manipulator, which positions the origin of the tool frame at an arbitrary 3-dimensional Cartesian position.