16-711 Kinematics, Dynamic Systems, and Control
Spring term, 2000
Problem Set 7

Due: beginning of lecture, Thursday, May 4

1. *Robot dynamics:* Problem 4.3 from Sciavicco and Siciliano. Consider the actuators to be "ideal," having no mass or inertia.

2. *Robot dynamics:* Problem 4.5 from Sciavicco and Siciliano. Include actuator mass, inertia, and transmission gear reduction ratios so that your derivation mirrors the derivation in Section 4.3.2.

3. *Lyapunov stability:*

   (a) Show that the following time-varying system is stable in the sense of Lyapunov for $t > 0$.

$$\begin{aligned} \dot{x_1} &= x_2 \\ \dot{x_2} &= -\sin^2(t)x_2 - (1+e^{-t})x_1 \end{aligned}$$

   (b) Is the system also asymptotically stable? Explain.

4. *Mechanism control:* Problem 6.12 from Sciavicco and Siciliano. Do not perform any simulation, but rather comment on the implication of choosing non-diagonal positive definite matrices for K_P and K_D. You should explain the effect on system stability and describe (qualitatively) how the mechanism will respond to disturbance forces applied to the end effector while at equilibrium.