Homework 8

1. (Problem 5.20 from textbook) We desire a joint space trajectory $\dot{q}_i^d(t)$ for the $i^{th}$ joint (assumed to be revolute) that begins at rest at position $q_0$ at time $t_0$ and reaches position $q_1$ in 2 seconds with a final velocity of 1 radian/sec. Compute an LSPB (linear segments with parabolic blends) trajectory to satisfy these requirements. Sketch the position, velocity, and acceleration profiles.

2. (Problem 5.22 from textbook) Write a Matlab m-file, lspb.m to generate an LSPB trajectory, given appropriate initial data.

3. Consider the “cart-pole” (or “cart-pendulum”) system shown below. This system has a cart (that can move along one direction, the $X$-axis), which has a pole attached to it through a revolute joint. Write the dynamics of this system using the Euler-Lagrange equations. Use $q = [d_1, \theta_2]^T$.

Let the mass of the cart be $m_1$ and the mass of the pole be $m_2$. Let the constant distance from the revolute joint to the center of mass of the pole be $l_2$. Let the moment of inertia of the pole (for rotation around the $Y$-axis) be $I_2$. Consider gravity as pointing downwards (along negative $Z$ direction).

4. (Problem 7.3 from textbook) Find the $3 \times 3$ inertia matrix (i.e., moments of inertia and cross products of inertia) of a uniform rectangular solid of sides $a$, $b$, $c$ with respect to a coordinate system with origin at one corner and axes along the edges of the solid.