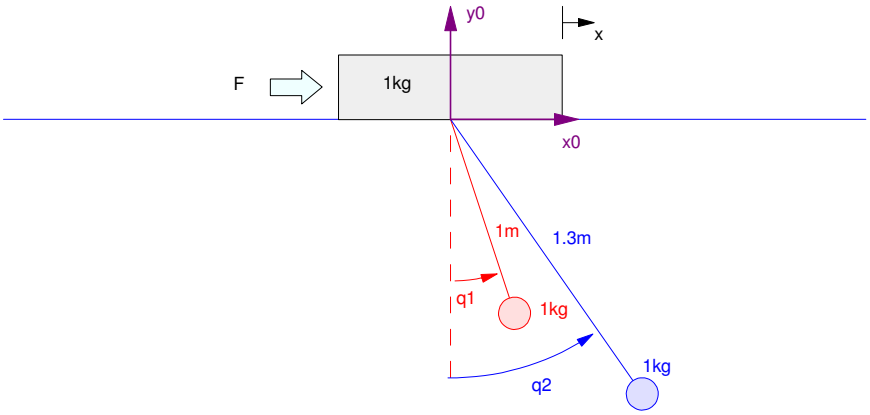
ECE 463/663 - Test #3: Name _____

Due midnight Sunday, May 8th. Individual Effort Only (no working in groups)



The linearized dynamics for a cart with two pendulums are:

$$s\begin{bmatrix} x \\ \theta_1 \\ \theta_2 \\ \dot{x} \\ \dot{\theta}_1 \\ \dot{\theta}_2 \end{bmatrix} = \begin{bmatrix} 0 & 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 1 \\ 0 & g & g & 0 & 0 & 0 \\ 0 & -2g & -g & 0 & 0 & 0 \\ 0 & -0.7692g & -1.5385g & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} x \\ \theta_1 \\ \theta_2 \\ \dot{x} \\ \dot{\theta}_1 \\ \dot{\theta}_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0 \\ 1 \\ -1 \\ -0.7692 \end{bmatrix} (F+d)$$

Design a feedback control law using LQR or LQG/LTR or VSS techniques (your pick) which results in

- A 2% settling time between 6 to 12 seconds
- Less than 10% overshoot for a step input, and
- An ability to track a constant set point

Turn in for your exam

- A block diagram of your plant and controller
- Matlab code used to determine your control law,
- The resulting control law
- A step response with respect Ref = 1, d = 1 for the linear model (above),
- A step response for the nonlinear simulation (Cart2 / Cart2Display / Cart2Dynamics) with your control law, and
- The main calling routine (Cart2.m) you used to generate this step response.

C Level (max 80 points)

Assume

- No noise
- All states are measured
- A constant set point, and
- A constant disturbance (d = 1)

B Level (max 90 points)

Assume

- No noise
- Only positions and angles are measured $\{x, \theta_1, \theta_2\}$
- A constant set point, and
- No disturbance (d = 0)

A Level (max 100 points)

Assume

- No noise
- Only positions and angles are measured $\{x, \theta_1, \theta_2\}$
- A constant set point, and
- An input disturbance (d = 1)

Bonus!

Derive the dynamics for this system