ECE 463/663 - Homework #13

LQG/LTR. Due Monday, April 29th
Please submit as a hard copy, email to jacob.glower@ndsu.edu, or submit on BlackBoard

LQG / LTR

For the cart and pendulum system of homework set #4:

$$s\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} = \begin{bmatrix} 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 1 \\ 0 & -2.45 & 0 & 0 \\ 0 & 9.42 & 0 & 0 \end{bmatrix}\begin{bmatrix} x \\ \theta \\ \dot{x} \\ \dot{\theta} \end{bmatrix} + \begin{bmatrix} 0 \\ 0 \\ 0.25 \\ -0.1923 \end{bmatrix}F$$

Design a control law so that the cart and pendulum system behaves like the following reference model:

$$y_m = \left(\frac{1}{s^2+s+1}\right)R$$

LQG/LTR without a Servo Compensator:

1) Give a block diagram for your controller

2) (20pt) Plot the step response of the model and the linearlized plant for yor control law for
   - $Q = 100\ e^2$
   - $Q = 1{,}000\ e^2$
   - $Q = 10{,}000\ e^2$

LQG/LTR with a Servo Compensator:

3) Give a block diagram for your controller plus servo compensator

4) (20pt) Plot the step response of the model and the linearlized plant for yor control law for
   - $Q = 100\ z^2$
   - $Q = 1{,}000\ z^2$
   - $Q = 10{,}000\ z^2$