

**ECSE 403 lab assignment**  
**Fall 2018 , assignment 7**  
**Instructor: Prof. P. E. Caines**  
**Due 30<sup>th</sup> November 2018**

Lab TA: Borna Sayedana

## 1 Objective

The main goal of this assignment is to design and implement controller for inverted pendulum system using state feedback controller and LQR method.

## 2 Your responsibility

Your responsibility is to answer all questions which have been asked throughout this assignment and submit all your answers in addition to Matlab codes and Simulink results.

## 3 Questions

1. Repeat the steps in lab 6 and design a state feedback controller based on dominant poles technique for the longer bar.(mass and length should be doubled)
2. Define your problem as a LQR problem, and define proper  $Q$ ,  $R$  matrices.  
**Hint:** You can restrict your attention into  $Q$  of the diagonal form.(also notice that by penalizing the elements of velocity and angular velocity you are making your systems slower.)
3. Describe intuitively how you choose the costs for each of the parameters to stabilize the system.
4. Using *lqr* command, find proper gains for the state feedback controller.

5. Try to stabilize the pendulum, if your gains are not working properly, redefine your cost function and design your controller again.
6. Using the best controller you found, start to gradually change your feedback gains. Describe intuitively the effect of an increment in each of these gains.
7. Repeat question 2-6 for the longer bar.
8. In your report include the costs you chose along with the state feedback gains.