ENEE 664 Optimal Control, Problem Set 4 due back in class Monday, February 29, 2016

Problem 1

Consider the problem of finding $x(t)$ such that $x(0) = 1$ and $x(1) = \pi$ and the figure of merit

$$\eta = \int_0^1 (\dot{x}^2 - 2t\dot{x})dt$$

is *minimized*. Use optimal control theory to solve this problem.

Problem 2

Consider the scalar system $\dot{x} = x + u$. It is desired to find a control law for the control u such that the state x tracks $\exp t$. Determine such a law by minimizing

$$\int_0^T \left\{u^2(t) + (x(t) - \exp t)^2\right\} dt.$$

Does the choice of time horizon T matter?

Problem 3

In Lecture Notes 2, solve the free end point problem by setting the terminal cost to be of the form

$$(x(T) - d)' \; Q \; (x(T) - d)$$

where T denotes terminal time, the prime denotes transpose, Q is a symmetric matrix and d denotes a fixed vector.

Problem 4

In Lecture Notes 3, Theorem on Necessary Conditions for Optimality (on page 5), prove the part (c) left as an exercise.