Final Review

EEET–427–01: Controls Systems

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1 Core Elements of Controls Systems

- Making Models
  A visual or mathematical model that represents the control system. This shows how the system operates and what variables can be manipulated to tune the system.
- Trajectory Generation
  Using the model to predict how a system will react. This allows us to estimate what the outcomes of various inputs will be without manually testing every input. This is all about finding the right input for the right output. Another way of wording it is putting bounds on the input to ensure that you don't attempt to overwork the system.
- Disturbance Decoupling
  Accounting for unwanted signals in a system such as drag or friction, by either feedback or feedforward.
- Feedforward
  A signal using information what we already have from a model of the system to give the controller a more stable starting point.
- Feedback
  Using the output of a system as part of its model to obtain a more accurate response, introducing stability.
- Lead Compensation
  Increases the stability of a system by adding the right amount of phase at a particular frequency. An example might be:
  $$G(s) = \frac{T_s + 1}{\alpha T_s + 1} \tag{1}$$
  where α depends on how much phase you want to add, and T_s is where you want to put the phase addition (at $|GH| = 0dB$)
- Integral Compensation
  Reducing steady-state error. This reduces overshoot, but also decreases stability.
- Lag Compensation
  Used to reduce integral windup in a system by increasing feedback in a system.

2 First Order Systems

A first order system is given a step input, and the output of the system is measured to have a risetime (10% to 90%) of $0.04s$. Make a model of this system, ignoring DC gain. Where is the pole located (expressed in rad/sec).