

Topics for Quiz 1

16.060: Principles of Automatic Control

October 8, 2003

Here is a list of the major topics we have covered in Lectures 1-14, which is the material that will be covered on the upcoming quiz. If you find it helpful, use this list as a guide for studying, but don't rely exclusively on it. Instead, do as much of the following as you can:

- Read through *all* your lecture notes for Lectures 1-14, and write down the key concepts and formulas from each lecture. If you come across anything you don't understand, spend some time trying to figure it out. If you still don't understand, ask one of the TAs.
- Review the problem sets and the problem set solutions. Pay close attention to any problems that you got wrong or did not complete. Make sure you understand what you did wrong, and be confident that you would be able to solve any of those problems if they come up again on a quiz.
- Work through any practice problems or practice quizzes that are provided. Again, ask for help if you come across anything that you can't understand.

Control System Analysis

- Open-loop vs. closed-loop control
- What is a transfer function?
- The standard block diagram
- Motivations for feedback
- The concept of gain
- Block diagram reduction
 - Making a system unity feedback
- Disturbances and parameter variations
- Sensitivity functions
- How to get good tracking and good disturbance rejection
- Steady-state errors
- Calculating gain and type number
- The steady-state error table
- Poles and zeros in the s-plane
- Calculating the inverse Laplace transform to get the transient response
- Graphical determination of residues: real poles and complex conjugate poles
- Root locus gain
- Stability
- Formulas for transient response for a simple lag or a quadratic lag system

- Dominant modes
- Transient response performance measures (T_s , $P.O.$, T_p , T_r)
- Effects of zeros
 - Effect of a zero on a dominant quadratic mode
 - Effect of a zero close to a pole
- Relationship between open-loop poles and zeros, and closed-loop poles and zeros

State-Space Methods

- The concept of state variables
- State space model ($\dot{\vec{x}} = A\vec{x} + B\vec{u}$, $\vec{y} = C\vec{x} + D\vec{u}$)
- Getting the state-space model from a differential equation
- Getting the transfer function from a state-space model
- The state-transition matrix
 - How to calculate it
 - How to use it to get $\vec{x}(t)$ in terms of $\vec{x}(0)$