ME461 Automatic Control: Syllabus, Fall 2008 – Tim Gordon

Introduction and course overview – automatic control, why and where is it used (examples) overview of main concepts: feedback vs. open loop control, performance measures, analogue and digital control.

Laplace transforms – review of methods and standard results, especially the solution of linear differential equations, transfer functions, block diagrams.

Dynamic modeling and model properties - differential equations, transfer functions, state-space forms of system models; conversion between types; block diagrams and prototype feedback control systems, performance metrics, standard first-order and second-order systems, impulse and step responses, effect of poles and zeros, steady-state error.

PID control – definition, effects of the proportional, integral and derivative terms, choice of gains in simple cases, Ziegler-Nichols methods.

Root locus methods – characteristic equation, definition of the root locus (RL), rules for sketching the RL, control system design using root locus techniques, lead and lag compensators, Matlab RLTOOL, pre-compensators and sensitivity function.

Frequency response methods – frequency response function, Bode plots, Nyquist plots, stability conditions, gain and phase margins, relative stability, M-circles, lead/lag compensator designs.

State-space control – stability, full state feedback, controllability, control canonical form, pole placement, state observer, observer canonical form and placement of observer poles, introduction to linear optimal control.

The course makes wide use of Matlab to represent and simulate control systems. A group project (2 or 3 students per group) on control system design is included in the course; this makes use of Matlab and Simulink for simulation and design.