ELE 380: CONTROL SYSTEMS I (required)

Credit: 4 hours.

Catalog Description: Control system modeling for electromechanical systems using block diagram, flow chart, flow graphs, and derivation of transfer function using Laplace transforms. Time and frequency domain analysis and controller design using root-locus, Routh-Hurwitz stability method, and Bode Plots. Software for control system used as an aid in the control system analysis and design process.

Prerequisites: ELE 315 and ELE 330 or ELE 215 and MEE 321.

Textbooks(s) and/or Other Required Materials: Automatic Control Systems, 8th edition, B.J. Kuo and F. Golnaraghi, John Wiley and Sons, 2003.

Topics Covered:

1. Introduction (Chap. 1)
2. Mathematical modeling- the tools (Chap. 2)
3. Block diagrams and signal-flow graphs (Chap. 3)
4. Modeling of physical systems (Chap. 4)
5. Stability of linear control systems (Chap. 6)
6. Time response (Chap. 7)
7. Root locus technique (Chap. 8)
9. Design of control systems (Chap. 10.1-10.4, 10.8-10.11)

Class/Laboratory Schedule:

Lecture: 3 hours/week
Lab: 2 hours/week

Course Objectives and Relationship to Program Outcomes:

1. Give students in electrical/mechanical engineering an introduction to automatic control systems. (Outcome F, I, K).
2. Learn the basic theories in linear control. (Outcome A).
3. Apply control theory to practical engineering analysis and design. (Outcome B, E, K).
4. Learn how to write lab reports.(Outcome G).

The lab assignments for this course allow the student to use test equipment to observe the operation of circuits used in control and motor systems. Several laboratory sessions are utilized in instructing the students on proper operation of the power supply, digital multimeter, oscilloscope, function generator and frequency counter for use in laboratory experiments. The student will utilize operational amplifiers and PLLs in several circuits. Circuits are simulated using PSPICE on the personal computer. Most of the experiments require the students do some
design before beginning the experiment. The following is a list of the lab assignments for this course:

1. Summer using Operational Amplifiers (2 classes)
2. Operational Amplifier Integrators/Differentiators (3 classes)
3. Response of a Second Order System (3 classes)
4. Modeling the Components of a PLL (2 classes)
5. Step Response of a PLL as a Second Order System (3 classes)
6. Analysis of DC Motor in a Closed Loop System (1 class)
7. Qualitative Analysis of the Modular Servo System, MS150 (1 class)

These experiments relate to the lectures given on:

1. Solution of differential equations on AC
2. Signal flow graphs
3. Stability analysis using Routh Hurwitz and root locus
4. Design of analog controllers
5. DC motors

All experiments correlate theoretical calculations with measured results.

**Coverage (and level) of ABET Outcomes:** A (3), B (2), E (3), F (1), G (2), I (2) and K (2).

**Contribution of Course to meeting the Professional Component:**

Engineering Topics: 100%

**Date:** June 2004.