Department	Electrical and Computer Engineering
Course Number	**EE 321**
Course Title	Control Systems I
University Catalog Description	Semester offered: S, Su 3 credit lecture Prerequisite: EE 308. Analysis and design of continuous linear feedback systems; mathematical characterization of systems; stability theory and signal flow analysis; root locus, Nyquist and frequency response techniques; compensator and controller types; describing function analysis.
Faculty Coordinator	Dr. S. R. Shaw
Prerequisites by Topic	Laplace transforms; calculus and differential equations; electrical circuit analysis; MATLAB.
Textbook	Van de Vegte, Feedback Control Systems (third edition), Prentice-Hall, 1994.
Course Objectives	To produce graduates who can design and analyze classical control systems.
Course Outcomes	At the conclusion of EE 321, students are expected to be able to: 1) Characterize linear electrical and mechanical systems using Laplace transforms. 2) Analyze and describe interconnected systems using block diagrams and signal-flow graphs. 3) Determine sinusoidal steady-state relationships based on Laplace transform transfer functions. 4) Generate transfer representations of a system given associated block diagrams, and visa versa. 5) Determine equilibrium points of nonlinear dynamic systems and find a linearized system model in the neighborhood of a given equilibrium point. 6) Determine step-response properties of first and second-order systems. 7) Determine all transfer functions associated with a feedback system. 8) Use root locus methods to sketch the locations of closed-loop poles as a function of any gain in the loop. 9) Use root locus concepts to design series compensators. 10) Use frequency-domain techniques to design series and minor loop compensators. 11) Use the Nyquist stability criterion to determine the range of gain for stability. 12) Use Nyquist and describing function techniques to predict existence, frequency and amplitude of limit cycles in nonlinear systems. 13) Use MATLAB to analyze, design, and simulate control systems. 14) Effectively communicate the results of their work.
Topics Covered	1) Introduction; the role that control engineering plays; course overview 2) Laplace transform methods applied to electrical circuits, translational and rotational mechanical systems; transfer functions. 3) Time and frequency domain modeling; poles and zeros; block diagrams and block diagram reduction; linearization. 4) Time response; rise time; overshoot; settling time; estimates of response times based on dominant 2nd order system characteristics; sinusoidal steady-state response. Use of MATLAB for both analysis and design. Steady-state performance. 5) Root locus for analysis and design; series compensation. 6) Relative stability measures; Nyquist techniques for stability analysis. 7) Bode design techniques for open-loop stable systems. Bode performance specifications. Series compensation using Bode techniques. 8) Minor loop compensation. 9) Describing function analysis of nonlinearities and nonlinear feedback systems.
Class/Laboratory Schedule	EE 321 meets three times/week for 50 minutes each session.
Professional Component (Criterion 5)	This course enables engineers to work with closed-loop feedback systems, to understand implications of feedback, and to analyze and design linear continuous-time feedback systems. Many of the senior design projects require a solid foundation in feedback control for successful project completion

ECE Program Outcomes	EE 321 supports the following Program Outcomes: a. An ability to apply knowledge of mathematics, science, and engineering. c. An ability to design a system, component, or process to meet desired needs. e. An ability to identify, formulate, and solve engineering problems. k. An ability to use the techniques, skills and modern engineering tools necessary for engineering practice.
Total Hours	3
Prepared by	S. R. Shaw 5/14/2009