ECE311: Feedback and Control

(Fall 2015)

Instructor: R. Tymerski, FAB 160-18.
Office Hours: see web site www.pdx.edu/ece/faculty-office-hours
Web site: www.ece.pdx.edu/~tymerski

TA: TBD

Course Learning Objectives:

1) To apply classical control principles to the design of continuous time control systems, and
2) To obtain proficiency with software (Matlab/Simulink) that aids in the design process.

Text book:

Design of Feedback Control Systems, R. Stefani, B. Shahian, C. Savant, and G. Hostetter, 4th Edition, Oxford University Press, 2002.

Useful reference:

Applied Classical and Modern Control System Design, by R. Tymerski et al. Provided on course web site.

Grading system:

Homework:		7%
In class problems/attendance		3%
Mid-term exam:	Week 6, 2nd class (11/4)	25%
Final exam:	Week 10, 2nd class (12/2)	35%
Matlab/Simulink Project and presentation:	Finals week	30%

The project will be in three parts worth 5%, 10% and 15% delivered at different dates. The format for the exams is multiple choice questions. You will need to bring a Scantron form (Form no. 882-E) with you as well as a calculator, and No. 2 pencil and eraser. No make-up exams will be given.

Content: This course introduces classical control theory for the feedback design of continuous time SISO systems. The material covered is in Chapters 1 to 7 of the text. Not all material in these chapters will be covered.

Notes:

1) A set of notes is available at the course website: www.ece.pdx.edu/~tymerski

2) Recommended exercise problems will be given which students are expected to do, *as a minimum*. The solutions to all problems in the form of the solutions' manual for the text is available at the ECE311 section of the instructor's web site.

Syllabus:

Topics	Topics covered
1	Block Diagrams - Transfer Function Representation as a Block Diagram - Block Diagram Analysis
2	Signal Flow Graphs - Mason's Gain Rule
3	System Response - Response of First-Order Systems - Response of Second-Order Systems - - Undamped Natural Frequency and Damping Ratio - - Overshoot, rise time and settling time
4	Stability Analysis - Coefficient Tests for Stability - - First and Second Order Systems - - Higher Order Systems - Routh-Hurwitz Test for Stability - - Possible Problems when forming Routh Array - -- Left-Column Zeroes of the Routh Array - -- Premature Termination of the Routh Array
5	Applications of Routh-Hurwitz Test - Parameter Shifting - - Adjustable Systems - - Relative Stability - Kharitonov's Theorem
6	Tracking Systems - Input signal characterization: step, ramp and parabolic - Steady State Error Analysis - -- T_E Approach - -- Unity-Gain Feedback Approach - --- Steady State Error Coefficients - Optimizing Control Systems - -- Performance integral indices - Control System Sensitivity
7	Three-Term (PID) Controllers - Ziegler - Nichols - Chien - Hrones – Reswick

8	<u>Root Locus for Feedback Systems</u> - Pole Zero Plots - Root Locus Plot Construction Rules for Negative Feedback Systems - Root Locus Using Matlab
9	<u>Frequency Response</u> - Steady State System Analysis for Sinusoidal Input - Magnitude and Phase Response – Bode Plots - Closed Loop Stability Using Bode Plots - - Phase and Gain Margins - Straight Line Asymptote Bode Plot Construction - Matlab Functions: Bode, unwrap
10	<u>Design of Controllers Using Bode Plots</u> - Simple Feedback System Design and Simulation Using Matlab/Simulink - Practical Example Feedback System Overview - – DC to DC Switching Power Converter - Various Controller Designs for Above System