ENEE 460: Control Systems (3 credits) Fall 2016 MW 5:00pm – 6:15pm KEB 1200

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Class Website: http://www.ece.umd.edu/class/enee460.F2016/

Course Goals: This course is intended to provide a rigorous and physically-motivated, model-based introduction to the structure and analysis of dynamical systems with inputs and outputs, and the design of controllers for such systems. Illustrative cases of nonlinear physical systems will be modeled approximately as linear systems, and hence a theory of linear control systems will be presented. Fundamental concepts of solutions, internal (state-space) and external (input-output map or transfer function) descriptions, concepts of controllability, observability, stability of zero solution, canonical forms, realization of state space models from external data, and feedback and its effect on spectral properties, form the **core** of the course. Material from linear algebra and linear differential equations including (Fourier, Laplace) transform domain form a **foundation** for the course. A central **purpose** of this course will be to understand how feedback and other interconnections of systems solve practical problems with specified performance requirements. Tools based on complex variables such as root locus, Bode and Nyquist plots will be exploited to this end. Systematic methods of feedback compensation in the time and frequency domain will be developed in the class. The subject will be richly illustrated by the enormous variety of control systems essential to (modern) life.

Textbook: *Feedback Systems: An Introduction for Scientists and Engineers* by Karl J. Åström and Richard M. Murray, (2008) Princeton University Press, Princeton, NJ, ISBN 978-0-691-13576-2; http://www.cds.caltech.edu/~murray/amwiki/index.php/Main_Page is the web resource for the book including latest versions, corrections and supplements.

Optional Topics: Bode integrals; Riccati equations.

Course Prerequisite: ENEE 322 and completion of all lower-division technical courses in the EE curriculum. **Topic Prerequisite**: Good preparation in Linear Algebra and Differential Equations, and ability to work with the software tool MATLAB-SIMULINK.

Grading: Weekly homework sets will be collected and graded. Group discussions of homework problems are encouraged, but submit only individual work. There will be two mid-term examinations and a final examination: (i) first mid-term on Monday, **September 26** (in class, closed book); (ii) second mid-term rescheduled to Wednesday, **November 9** (in class, closed book); (iii) final examination on **Saturday, December 17 (in class, closed book), 4:00 – 6:00 pm**. The breakdown in weighting towards the final grade will be: homework 10%, mid-terms 25% each, and finals 40%. Review carefully http://www.ugst.umd.edu/courserelatedpolicies.html for general policies and resources.

Policy on Classroom Environment
It is of utmost importance to maintain a classroom environment conducive to focus on and attention to instruction. Hence use of electronic devices (music equipment, cell phones, text messaging devices and computers) is **disallowed** during regular class hours. All cell phones should be kept turned **OFF** during class. Students interested in taking notes using tablets or recording audio should seek permission of instructor.