ENEE 661: Nonlinear Control Systems  (Tue-Thu 2:00-3:15, Spring 2005, EGR 1104)

Instructor:  P. S. Krishnaprasad (krishna@isr.umd.edu; 301-405-6843). Office is in A.V. Williams Building - room 2233. Office hours: M 4:00-6:00 and Tue 5:00 -7:00.

Course Goals: This course is intended to introduce the student to the analysis of the qualitative behavior of nonlinear systems, and the synthesis and design of controllers for such systems. Techniques include Lyapunov's direct method, linearization, frequency domain stability analysis, and functional analysis methods. Additionally, techniques with a geometric flavor, including center manifold reduction, Lie algebraic approaches to nonlinear control systems, and elementary bifurcation analysis will be introduced.

Course Prerequisite: ENEE 460 or equivalent. Co-requisite ENEE 663 or permission of instructor. A prior course in advanced calculus (e.g. MATH 410) is recommended. A good course in differential equations would also serve as adequate mathematics background.

Topic Prerequisite: It is desirable that the student be familiar with basic concepts and tools from linear system theory including, the Nyquist criterion, matrix exponentials and the variation of constants formula, controllability, observability and stabilizability. It would be helpful (but not essential) to be familiar with normed vector spaces, the Inverse Function Theorem, and the Implicit Function Theorem.

References:

The mathematical background can be found in any standard textbook on advanced calculus. We also strongly recommend
For background material on frequency domain methods in linear systems, see
For background material on state space theory of linear systems, see
Core Topics:

1. Existence, uniqueness and continuous dependence on initial conditions of solutions to ordinary differential equations.
4. Linearization Theorem. Stability and instability results.
5. Linearization Theorem for periodic systems. Floquet theory.
7. Absolute stability (Circle and Popov criteria) and passivity.
8. Stabilization using state feedback (via linearization).


Grading: Weekly homework sets (30%), Mid-term examination on Tuesday March 15 (30%), and Final Examination (40%) to be held in two parts – in class, Thursday May 19, 10:30 a.m. – 12:30 p.m., and take home the same evening for a maximum of 5 hours of work. The mid-term and the in-class part of the final examination will be of the closed-book variety.