ME/SE 762 *Joy of* Nonlinear Systems and Control

Spring 2010 Tues/Thur 12-2PM SOC B61

Instructor:

Prof. Hua Wang, Room 128, 15 St. Mary's Street, 353-8860, wangh@bu.edu

Office Hours:

Tuesday & Thursday 2:30PM – 3:30PM and/or by appointment or feel free to drop by my office whenever I am available.

Grading and Protocols:

Homework will be assigned weekly and is due a week after.

Midterm will be on Thursday, March 25.

Homework and attendance	40%
Midterm	30%
Project	30%

Course Goals:

Nonlinear systems are the norm in nature rather than the exception. The goal of this course is to introduce the students to the analysis of the qualitative behavior of nonlinear systems and the design and synthesis of controllers for such systems. The course is intended for graduate and upper class undergraduate students in engineering (including mechanical engineering, electrical engineering, and biomedical engineering), physics and applied mathematics. Techniques include the Lyapunov's direct method, linearization, frequency domain stability analysis, and functional analysis methods. The course aims to instill interest in and appreciation of nonlinear systems and control.

Course Prerequisites:

ME/EC/SE 501 or equivalent is preferred prerequisite though not essential.

References:

The textbook is: H.K. Khalil, Nonlinear Systems (third edition), Prentice-Hall, Englewood Cliffs, New Jersey (2001).

Core Topics:

1. Existence, uniqueness, and continuous dependence on initial conditions for ordinary differential equations.

2. Lyapunov's direct method for both time-invariant and time-varying systems. Stability and instabililty results. Lasalle's Invariance Principle.
3. Linearization Theorem for both time-invariant and time-varying systems. Stability and instability results.
4. Stabilization using state feedback (via linearization).
5. Feedback linearization. Relative degree and zero dynamics.
6. Lyapunov-based design (backstepping, sliding mode control and adaptive control)

Optional Topics:

Input-output stability and the Small Gain Theorem, Absolute stability (including Circle and Popov Criteria). Singular perturbations. Bifurcations and chaos. Center manifolds. Oscillatory Control.