IE 533 (3 credit hours)
Systems Theory

Spring Semester 2009
(Lecture days and times –tentative-: T 11:00-12:30; W 11:00-12:30. Occasional lab: T 12:00)

PREREQUISITES: Graduate standing or senior with >2.50 GPA (AND instructor's consent)
INSTRUCTOR: Yaman Barlas, tel. 6407.
OFFICE HOURS: Tuesday: 9:30-11:00
Wednesday:14:00-17:00
(Please call and make an appointment if you must see me outside the office hours).

COURSE OBJECTIVES: This is a course on the philosophy, science and tools of systems theory, emphasizing various mathematical and quasi-mathematical techniques used in dynamic modeling and analysis of complex systems. Examples from socio-economic, managerial and other living systems are modeled and discussed. Low order and linear systems are initially used to introduce the main concepts, but special emphasis is eventually placed on realistic, non-linear, time-delayed complex models. Student projects and other assignments play a major role in the course. Simulation software will be used in analysis of large-scale models.

REQUIRED TEXT:
No single textbook is required.

REFERENCE TEXTS:
1- Forrester, J.W., Industrial Dynamics. Cambridge, Massachusetts:MIT Press, 1961.
2- Sterman, J. Business Dynamics. Systems Thinking and Modeling for a Complex World. McGraw-Hill, U.S.A., 2000.
3- Barlas, Y. "System Dynamics: Systemic Feedback Modeling for Policy Analysis" in Knowledge for Sustainable Development - An Insight into the Encyclopedia of Life Support Systems, UNESCO-Eolss Publishers, Paris, Oxford, UK. 2002, pp.1131-1175.
4- Burghes, D.N. and M.S. Borrie.Modeling With Differential Equations. Chichester, England: Ellis Horwood, 1982.
5- Drazin, P.G. Non-linear Systems. Cambridge, England: Cambridge University Press, 1992.

GRADING:		
	Assignments:	15%
	Midterm Exam:	25%
	Comprehensive Exam:	30%
	Literature Review:	10%
	Project:	20%

ASSIGNMENTS: There will be several homework assignments. Due dates of each assignment will be announced ahead of time during the semester. All assignments are to be worked on individually by each student. NO assignment is accepted after the due date.

EXAMS: There will be one in-class midterm exam and one in-class final comprehensive exam at the end of the semester. More specific information on the nature of these exams will be provided during the semester.

LITERATURE REVIEW: Each student will be asked to do a methodological literature survey, and submit the bibliography obtained in the process. The student will write a short article, summarizing his/her library review. At the end, each student will make a short presentation.

PROJECT: Each student is required to work on a term project. The project can be of methodological or applied nature. Suggested topics will be announced around the mid-term. Students are expected to form their teams and select their project topics after the mid-term. At the end, a presentation and project report will be due.

OUTLINE

WEEK	TOPIC .
1	Course Objective, Organization and Method Overview
2	System Dynamics and Differential Equations
2	Introduction to systems theory and science
3	First order and second order linear systems
4	Nonlinear formulations and feedback models
5	Time delay formulations
6	Complexity of systems: philosophy and principles
7	Systems Simulation as a Numerical Method
8	Linear Systems Theory
8	MIDTERM EXAM
9	Equilibrium Analysis and Examples
10	Stability Analysis and Phase Planes
11	Linearization and Applications.
12	Discrete versus Continuous Models
13	Model validity and validation
13	Sensitivity Analysis and Policy Design