IE 550
Dynamics of Socio-Economic Systems
Fall Semester 2015

Prerequisites: Graduate standing or senior with >2.50 GPA (and instructor consent)

Class/Lab/PS schedule: Tuesday 15:00-16:30 - Class lecture
Thursday 13:30-15:00 - Class lecture
Tuesday 16:00-17:00 – Occasional PS or Lab

Instructor: Yaman Barlas
Room M4045, tel. 6407
Office Hours: Tuesday 11:00 –13:00
Wednesday 15:00 -16:30
(Please call and make an appointment if you must see me outside the office hours)

Assistant: TBA (SESDYN Lab)

Course Objectives: This is a course on using systems thinking and system dynamics methodology to understand complex, dynamic socioeconomic and managerial problems. The course has two primary objectives: The first one is to learn System Dynamics, a simulation-based methodology to analyze the complex dynamics of contemporary socio-technical problems. Basic tools of dynamic feedback modeling, the important role of time delays and nonlinearities will be covered. Students will also see some existing simulation models of case studies ("microworlds") ranging from ecological to business issues, from biological to social problems. The second objective is to enable the students build and analyze their own dynamic models. Using a modeling software (such as STELLA, VENSIM,...), students will build models of dynamic problems they are familiar with, and analyze their models so as to obtain creative solutions.

Reference Texts:

1- Sterman, J. Business Dynamics. Systems Thinking and Modeling for a Complex World. McGraw-Hill, U.S.A., 2000.
2- 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.
3- Roberts, Nancy, D. Andersen, R. Deal, M. Garet and W. Shaffer. Introduction to Computer Simulation: A System Dynamics Approach. Reading, Massachusetts: Addison-Wesley, 1983.
4- Forrester, J.W., Industrial Dynamics. Cambridge, Massachusetts:MIT Press, 1961.
5- Any standard textbook on applied differential equations.

Grading:

Assignments:	15%
Midterm Exam:	25% (28% for undergraduates)
Final Exam:	30% (37% for undergraduates)
Literature Review:	10% (none for undergraduates)
Project:	20%

Homework And Project Assignments: There will be several homework assignments and a larger project assignment. Due dates of each assignment will be announced ahead of time during the semester. All homeworks are to be worked on individually by each student. Cooperation can take place only at a general and conceptual level (which is positive and should be encouraged). But each student is required to do the specific work of a given assignment individually. Term projects will be done by teams of 2-3 students. **No** assignment will be accepted after the due date. Graduate students will also have a literature review assignment.

Exams: There will be a midterm exam during the semester, and a comprehensive final examination* at the end. More specific information on the nature of these exams will be provided before each one.
*Important note: To be admitted to the final exam, a student must obtain a 'final exam visa'. The requirements to obtain final exam visa are: i- to have had the midterm exam, AND ii- to have accumulated at least 25% of the total score, from the midterm exam and homework assignments (+ literature review for the graduate students).

Attendance And Class Participation: The lectures will be intense and involve student participation, so attendance is crucial and required. The class will occasionally meet in a computer laboratory and students will be asked to experiment with their models and actively participate in the related class discussions.

WEEK	TOPIC
1	Course Organization and Overview
1	Dynamic Problems and Models
2	Structure and Dynamic Behavior; Illustrations.
2	Systems Thinking, Complex Systems, Problems
3	System dynamics methodology
3	Systems Modeling Tools: Stock and Flow Variables.
4	Basic Stock-Flow Dynamics
4	Feedback loops: Positive and Negative Feedback
5	Introduction to software and computational issues
5	Behavior of positive feedback loop; growth processes.
6	Behavior of negative feedback loop; examples.
6	Concepts of Equilibrium and Stability.
7	Coupling of positive and negative feedback loops
7	Causal-loop Diagrams; examples.
8	Midterm EXAM
8	S-shaped behavior and "boom and bust" patterns.
9	Linear and non-linear equation formulation.
10	Role and importance of time delays in systems
10	Structure of cyclic (oscillatory) systems.
11	Generic Structures and uses of generic sub-systems
11	Uses of Test Inputs and Noise
12	Model Credibility (Validity) and Testing
12	Guidelines for building "good models"
13	Model Analysis and Model Implementation
13	Term Project Presentations