The prerequisite for the course is knowledge of basic courses in mathematics and numerical analysis, or the equivalent. Some experience of computer programming and the use of computers is assumed. The homework and computer laboratories constitute a very important part of the course. Computer assignments will be done in STELLA (http://www.iseesystems.com/) and MATLAB (http://www.mathworks.com/) with existing software for the student to experiment with.

The goal of this course is to give basic knowledge of modeling, especially for problems involving intangible variables/parameters, inspired by problems in dynamics of infectious diseases, business cycles, speculative bubbles, and crashes and evolutionary dynamics in complex systems. The course treats basic theory of learning in and about complex systems, the modeling process, the structure-behavior relationships of dynamical systems and the tools for modeling delays, decision making, and human behavior. Upon completion of the course the student should be able to formulate fundamental modes of dynamic behavior, such as exponential growth, goal seeking tendencies, oscillatory processes, s-shaped growth, overshoot and collapse, and their interactions; draw causal loop diagrams and differentiate between correlation and causality; implement realized models by STELLA and interpret the resulting dynamics; investigate analytically the dynamics of simple structures; construct models for path dependent behavior and positive feedback.

Textbook:

References:

Weeks   Topics
1       The nature of systems and systems of the nature (Ackoff, Part I)
2-3     Structure and behavior of dynamic systems (Sterman, Ch 4)
        Introduction to simulations with Stella
4       Causation versus correlation – causal loop diagrams (Pearl, Ch 3; Sterman, Ch 5)
5-6     Dynamics of simple structures (Sterman, Ch 8)
7-8     A geometric way of thinking – flows and bifurcations (Strogatz, Ch 2-3)
9-10    Dynamics of growth: Population dynamics, epidemics (Britton, Ch 1-4, Sterman, Ch9)
11      Path dependence and positive feedback (Sterman Ch 10)
12-13   Transport: Kinetics and pathways (Britton, Ch 6)
14      Material and information delays (Sterman Ch 11)

Links:
http://www.systemdynamics.org/

Class Policies:
Two (2) in-class exams, 25% each of the final grade; Final exam: 30% of the final grade; Homework: 20% of the final grade