Upper-level Undergraduate/Graduate Course in Computational Neuroscience Courant Institute, NYU Instructor: John Rinzel with Horacio Rotstein (NJIT)

G63.2855 ADVANCED TOPICS IN MATHEMATICAL PHYSIOLOGY (Nonlinear Dynamics of Neuronal Systems) (Cross listed as NEURL-UA 302/NEURL-GA 3042 for Center for Neural Science) 3 points. Spring term, 2013. Friday, 3:30-5:20pm, WWH Rm 512 (Rm to be confirmed). J. Rinzel.

Prerequisite: Calculus II, some exposure to differential equations and Matlab (seek consent of instructor if in doubt).

We will develop and simulate mathematical (differential equation) models to understand the dynamical properties of neurons, synapses, and networks/systems. The foundations of dynamical systems theory and neurophysiology will be covered, as needed. We will study neuro-mechanistic models for spiking, synaptic integration, coupling and coordination in networks, and mean-field firing-rate activity. Case studies will include: network rhythms, sensory processing, and perceptual/cognitive dynamics such as decision-making, perceptual grouping and competition. Simulations, including visualization and animation, will be run using Matlab. The course will involve classroom lectures and interactive computing lab sessions, homework and a simulation project.

Books:

Spikes, Decisions, and Actions: The Dynamical Foundations of Neuroscience by HR Wilson. Oxford University Press 1999. Available, no cost, online: <u>http://cvr.yorku.ca/webpages/wilson.htm#book</u>