Provisional Schedule: The Principles of Biological Modeling (BIOL135b) Spring 2013

Instructor: Paul Miller, Volen 252  pmiller@brandeis.edu  Office Hours: Thur. 11-12, or appointment.
TA: Vivekanand Vimal, Rabb 85-1  vvimaldhye@gmail.com  Office Hours: Fri. 11-12.
Class meets  Mon., Wed. 1-1:50pm (SSC GL14);  Thur. 1-2pm (Farber Computer Rm, 101)
Homeworks due (preferably via email) to the TA before class on Monday following the week indicated.

Week 1     Jan 14th, 16th, 17th
Introduction to course, Matlab, exponential function and steady states.

Week 2     Jan 23rd, 24th
Michaelis-Menten kinetics, buffering.

Week 3     Jan 28th, Jan 30th, Jan 31st

Week 4     Feb 4th, 6th, 7th  HW1
Stochastic effects: Random walks: 1D (neural spiking), 2D (E.Coli chemotaxis).

Week 5     Feb 11th, 13th, 14th
Synchronized insect emergence. Microtubule dynamics.

Week 6     No Classes, Spring Break

Week 7     Feb 25th, 27th, 28th  HW2
Bistability and memory: shot noise and Gillespie algorithm.

Week 8     Mar 4th, 6th, 7th

Week 9     Mar 11th, 13th, 14th  MIDTERM MAR 14th
Neural Circuit Oscillations.

Week 10    Mar 18th, 20th, 21st
Chaos. Waves: diffusion in 1D and 2D. Fisher’s equation.

Week 11    No Classes, Easter Break  HW3

Week 12    Apr 3rd, 4th
Waves: Action potential in neurons (FitzHugh-Nagumo). Cardiac waves.

Week 13    Apr 8th, 10th, 11th  HW4
Feedback: feedback control and homeostasis.

Week 14    Apr 15th, 17th, 18th
Allele variation and genetic drift.

Week 15    Apr 22nd, 24th, 25th  HW5
Curve fitting and chi-squared testing of alternate hypotheses.

Week 16    Apr 29th, May 1st,
Makeup + Review class/exam preview: question and answer.

Goal of the course.
After taking this course, my hope is that you will be able to write a computer code to simulate the behavior of any simple model system of interest. With such a model you can add as many features as you wish and observe how each feature affects the behavior of the system. You should gain an intuition as to when you would expect to see stability, memory, oscillations, when random fluctuations are important, and how to judge the robustness of a system through simulation. En route to gaining these skills you should acquire some basic knowledge of population biology, cell biology and neuroscience.
Grading Policy for BIOL135b
Homeworks amount to 50% of final grade (10% each). 1% out of 10% lost for each day late. Be careful to answer questions fully as well as produce a working code for grading. Bonus questions are compulsory for Grad students (i.e. are necessary to score full marks) but are optional and can boost the individual homework score for undergraduates (note total homework score can not pass 50% i.e. bonus questions in HWs can make up for lost marks in other HWs if you are an undergrad).

In-class short-answer questions (Mon/Wed only) will count for 10% of final grade. These should be simple, so long as you are in class and attentive. Prior permission to miss class will mean the class is removed when calculating your average score.

Midterm exam will count for 10% of final grade. Final exam will count for 30% of final grade.