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
Population growth and predator-prey models: Lotka-Volterra.
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
Oscillations: Cyclin and the cell cycle. Circadian rhythm. Entrainment.
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.