Provisional Schedule for The Principles of Biological Modeling (BIOL135b) Spring 2009

Instructor: Paul Miller, Volen 253 pmiller@brandeis.edu **Office Hours: Thur. 11am-noon.**
TA: Mark Bourjaily, Volen 214 markbour@brandeis.edu **Office Hours: Wedn. 3:45-4:45pm**
Class meets Mon., Wed. 10:10-11am (Rosensteil 118); Thur. 10:10-11am (Goldfarb Computer Rm)
Homeworks due (preferably via email) to the TA by noon Friday of the week indicated.

Week 1 Jan 14th,15th
Introduction to course, Matlab and exponential function.

Week 2 Jan 20th, 21st, 22nd
Steady states (stable and unstable) Michaelis-Menten kinetics, buffering.

Week 3 Jan 26th, 28th, 29th **HW1 Due**
Population growth and predator-prey models: Lotka-Volterra.

Week 4 Feb 2nd, 4th, 5th
Stochastic effects: Random walks: 1D (neural spiking), 2D (E.Coli chemotaxis).

Week 5 Feb 9th, 11th, 12th **HW2 Due**
Synchronized insect emergence. Microtubule dynamics.

Week 6 No Classes, Spring Break

Week 7 Feb 23rd, 25th, 26th
Bistability and memory: shot noise and Gillespie algorithm

Week 8 Mar 2nd, 4th, 5th **HW3 Due**
Oscillations: Cyclin and the cell cycle. Circadian rhythm. Entrainment. Gamma rhythms.

Week 9 Mar 9th, 11th, 12th
Oscillations and phase planes: lobster stomatogastric ganglion. Chaos.

Week 10 Mar 16th, 18th, 19th **HW4 Due**
Waves: diffusion in 1D and 2D. Fisher's equation.

Week 11 Mar 23rd, 25th, 26th
Waves: Action potential in neurons (FitzHugh-Nagumo). Calcium waves.

Week 12 Mar 30th, Apr 1st, 2nd **HW5 Due**
Feedback: feedback control and homeostasis.

Week 13 Apr 6th, 8th (Apr 9th no class)
Allele variation and genetic drift.

Week 14 No Classes, Easter Break

Week 15 Apr 20th, 22nd, 23rd **HW6 Due**
Curve fitting and chi-squared testing of alternate hypotheses.

Week 16 Apr 29th
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 60% of final grade (10% each). 1pt 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 60% 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 15% 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.

Final exam will count for 25% of final grade.