

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.

<u>Week 1</u>	Jan 14 th , 16 th , 17 th Introduction to course, Matlab, exponential function and steady states.
<u>Week 2</u>	Jan 23 rd , 24 th Michaelis-Menten kinetics, buffering.
<u>Week 3</u>	Jan 28 th , Jan 30 th , Jan 31 st Population growth and predator-prey models: Lotka-Volterra.
<u>Week 4</u>	Feb 4 th , 6 th , 7 th HW1 Stochastic effects: Random walks: 1D (neural spiking), 2D (E.Coli chemotaxis).
<u>Week 5</u>	Feb 11 th , 13 th , 14 th Synchronized insect emergence. Microtubule dynamics.
<u>Week 6</u>	No Classes, Spring Break
<u>Week 7</u>	Feb 25 th , 27 th , 28 th HW2 Bistability and memory: shot noise and Gillespie algorithm.
<u>Week 8</u>	Mar 4 th , 6 th , 7 th Oscillations: Cyclin and the cell cycle. Circadian rhythm. Entrainment.
<u>Week 9</u>	Mar 11 th , 13 th , 14 th MIDTERM MAR 14th Neural Circuit Oscillations.
<u>Week 10</u>	Mar 18 th , 20 th , 21 st Chaos. Waves: diffusion in 1D and 2D. Fisher's equation.
<u>Week 11</u>	No Classes, Easter Break HW3
<u>Week 12</u>	Apr 3 rd , 4 th Waves: Action potential in neurons (FitzHugh-Nagumo). Cardiac waves.
<u>Week 13</u>	Apr 8 th , 10 th , 11 th HW4 Feedback: feedback control and homeostasis.
<u>Week 14</u>	Apr 15 th , 17 th , 18 th Allele variation and genetic drift.
<u>Week 15</u>	Apr 22 nd , 24 th , 25 th HW5 Curve fitting and chi-squared testing of alternate hypotheses.
<u>Week 16</u>	Apr 29 th , May 1 st , 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.