PHYS 585 Course Outline
Instructor: Steve Pressé

Outline:
Biophysics is the study of biological phenomena from the physics perspective with an emphasis on quantitative prediction, modeling and interpretation of data. Biophysics is a rapidly evolving and exciting area of experimental and theoretical research.

Students will learn about key biological phenomena as well as major experimental and theoretical methods of biophysics. Phenomena discussed will range from the single molecule up to the whole cell level and experiments discussed will include spectroscopy, imaging as well as standard biochemical techniques. Theoretical methods discussed will be motivated by the methods of statistical physics, polymer physics, statistics and stochastic processes.

I am not in physics, should I take this?:
This course is intrinsically cross-disciplinary. It is applicable to students of chemistry, biology, physics, engineering and medicine interested in a quantitative perspective on biology. If you are not in physics and are considering this course, please come talk to me. Basic knowledge of linear algebra, calculus, differential equations and statistics will be assumed. All other techniques will be presented in class in a self-contained fashion or explored in the problem sets.

Our Goals:
This course should help students transition into research and navigate the biophysical literature while providing students with an appreciation for the power of physical models applied to the biological sciences.

Grades:
Problem sets will be assigned approximately every week. Students can discuss the problem sets amongst themselves but must write-up their own solutions. Problem sets are due at 4pm on the due date (typically Friday); late problem sets are not accepted. Solutions will be posted online. An exam can be skipped or made up if an excuse for an *extenuating circumstance* can be substantiated. In this case, a doctor's note and or other proof is required. 60 is the passing grade. Active class participation is required. To get full grades in class participation, students are expected to attend all classes and routinely ask questions. (10% Class participation, 30% 2 Midterms, 30% Problem Sets, 30% Final).

Problem Sets:
We will arrange a time and set a room aside once a week for students to meet if they wish and discuss the current problem set. Also, many problem sets will have a simple computational component. You can tackle these problems using any language you choose. Higher level languages (such as Mathematica, Matlab or Python) will probably help you save time. I will provide a quick tutorial on how to use Mathematica (available for free through IUAnyware) for those who choose to use it for this class.

Studying for Tests/Exams:
The best way to study is to have completed and understood *all* of the assigned questions in the problem sets. If you feel you need extra practice, complete additional problems in the chapters covered in the required text. All midterms and the exam are closed book.

Required text:
1) R. Phillips, J. Kondev, J. Theriot, H. Garcia, "Physical Biology of the Cell", second Ed.

Helpful texts:
1) K. Dill, S. Bromberg, "Molecular Driving Forces"
2) P. Nelson, "Biological Physics"

Additional, more specialized, references:
1) P. Lee, "Introduction to Bayesian Statistics"
2) G. Casella and R. Berger, "Statistical Inference"
3) Zwanzig, "Non-equilibrium Statistical Mechanics"
4) Van Kampen, "Stochastic Processes in Physics and Chemistry"

Class Schedule

Week 1 (Aug 22nd - Aug 26th):
Lecture I (Chapter 1) and II (Chapter 2) –Nothing due.

Week 2 (Aug 29th - Sep 2nd):
Lecture III (Chapter 3) and IV (Chapter 4) –PSET 1 due.

Week 3 (Sep 5th - Sep 9th):
Lecture V (Intro to Mathematica and Review) and VI (Chapter 5) –PSET 2 due.

Week 4 (Sep 12th - Sep 16th):
Lecture VII (Chapter 6) and VIII (Chapter 7) –PSET 3 due.

Week 5 (Sep 19th - Sep 23rd):
Lecture IX (Chapter 8) and X (Chapter 9) –PSET 4 due.

Week 6 (Sep 26th - Sep 30th):
Lecture XI (Chapter 10) and XII (Chapter 11) –PSET 5 due.

Week 7 (Oct 3rd - Oct 7th):
Lecture XIII (Chapter 11 cont'd and Review) and Midterm I –Nothing due.

Week 8 (Oct 10th - Oct 14th):
Lecture XIV (Chapter 12) and XV (Chapter 13) –PSET 6 due.

Week 9 (Oct 17th - Oct 21st):
Fall Break and Lecture XVI (Chapter 14) –PSET 7 due.

Week 10 (Oct 24th - Oct 28th):
Lecture XVII (Chapter 15) and XVIII (Chapter 16) –PSET 8 due.

Week 11 (Oct 31st - Nov 4th):
Lecture XIX (Chapter 16 cont'd) and XX (Chapter 17) –PSET 9 due.

Week 12 (Nov 7th - Nov 11th):
Lecture XXI (Chapter 18) and Midterm II –Nothing due.

Week 13 (Nov 14th - Nov 18th):
Lecture XXII (Chapter 18 cont'd) and XXIII (Chapter 19) –PSET 10 due.

Week 14 (Nov 21st - Nov 25th):
Lecture XXIV (Chapter 19 cont'd) and Thanksgiving Holiday– Nothing due.

Week 15 (Nov 28th - Dec 2nd):
Lecture XXV (Chapter 20) and Lecture XXVI (Chapter 21) –PSET 11 due.

Week 16 (Dec 5th - Dec 9th):
Final Exam.