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 new 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; 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 a letter from the physics department chair are 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 though you can use C/C++ or Fortran. 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"

Other useful 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 25th - Aug 29th):
Lecture I (Chapter 1) and II (Chapter 2) –Nothing due.

Week 2 (Sep 1st - Sep 5th):
Lecture III (Chapter 3) and IV (Chapter 4) –PSET 1 due.

Week 3 (Sep 8th - Sep 12th):
Lecture V (Intro to Mathematica and Review) and VI (Chapter 5) –PSET 2 due.

Week 4 (Sep 15th - Sep 19th):
Lecture VII (Chapter 6) and VIII (Chapter 7) –PSET 3 due.

Week 5 (Sep 22nd - Sep 26th):
Lecture IX (Chapter 8) and X (Chapter 9) –PSET 4 due.

Week 6 (Sep 29th - Oct 3rd):
Lecture XI (Chapter 10) and XII (Chapter 11) –PSET 5 due.

Week 7 (Oct 6th - Oct 10th):
Lecture XIII (Chapter 11 cont'd and Review) and Midterm I –Nothing due.

Week 8 (Oct 13th - Oct 17th):
Lecture XIV (Chapter 12) and XV (Chapter 13) –PSET 6 due.

Week 9 (Oct 20th - Oct 24th):
Lecture XVI (Chapter 14) and XVII (Chapter 15) –PSET 7 due.

Week 10 (Oct 27th - Oct 31st):
Lecture XVIII (Chapter 15 cont'd) and XIX (Chapter 16) –PSET 8 due.

Week 11 (Nov 3rd - Nov 7th):
Lecture XX (Chapter 16 cont'd) and XXI (Chapter 17) –PSET 9 due.

Week 12 (Nov 10th - Nov 14th):
Lecture XXII (Chapter 18) and Midterm II –Nothing due.

Week 13 (Nov 17th - Nov 21st):
Lecture XXIII (Chapter 18 cont'd) and XXIV (Chapter 19) –PSET 10 due.

Week 14 (Nov 24th - Nov 28th):
Lecture XXV (Chapter 19 cont'd) and Thanksgiving Holiday– Nothing due.

Week 15 (Dec 1st - Dec 5th):
Lecture XXVI (Chapter 20) and Lecture XXVII (Chapter 21) –PSET 11 due.

Week 16 (Dec 8th - Dec 12th):
Final Exam.