SYLLABUS **Biological Physics PHY6700** **Fall 2011**

Time & Place: Tuesday & Thursday, 10:40 am – 12:30pm, **Room** 0199 Manoogian Hall.
Instructor: Dr. Takeshi Sakamoto, Assistant Professor, Department of Physics and Astronomy
Office hours: T 3-4, Th 3-4 or by appointment
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Textbook: Philip Nelson: Biological Physics, ISBN 0-7167-9897-2

Key Goal for Biological physics: Biological Physics deals with fundamental physical principles at the center of life's processes. In this course, we concentrate on the physics of from molecular dynamics through cellular processes. Biological touches on this course, we concentrate on many areas of physics, including thermodynamics, electrodymanics, kinetics, statistical mechanics. Thus, in addition to learning abouy the physics of life, this course will also serve as an introduction to these important areas of physics. We will also learn mathematical techniques in this course, as needed.

Level of course:
This course is a senior level undergraduate course. As such, we will learn how to analyze complex physical situations and use modestly advanced calculus. Students need to be aware this is not an easy course and a high level of attention and dedication is expected from students who want to achieve a grade of A or B. Understanding the course material will be assisted by weekly problem solving sessions, as well as quizzes and regular homework assignments.

Assignment:

Attendance **10%** **:** Will be taken every class

Homework **10%** **:** will be given weekly. Students will present their homework solution during our weekly problem solving session.

Problem solving **15%** **:** Handing in a problem as a homework, but not understanding the solution, will result in a loss of points for both the problem solving session and the handed-in homework . Problem solving will be grade on an honest effort basis, not on absolute correctness of solution presented. It is important to demonstrate you have spent effort and time to think about the problem and *can explain* how you arrive at your solution. Therefore, do **not** copy solutions from others. Instead, if you need help, discuss problems with your fellow students or with me.

Review Exam **5%** **:** is based on material from the text book already covered in PHY 4700. These previously covered topics are needed to understand the more advanced chapters in the book.

Mid-Exam (2x20%) 40% : will be 1 hour long.

Final Exam **20%** **:** is 2 hours.

Grading: The overall course grade will be determined on the basis of the following table:

Grade	Cumulated score	Grade	Cumulated score	Grade	Cumulated score
A	**91 – 100**	**B-**	**70 – 74**	**D+**	**50 – 54**
A-	**85 – 90**	**C+**	**65 – 69**	**D**	**45 - 49**
B+	**80 – 84**	**C**	**60 – 64**	**D-**	**40 - 44**
B	**75 - 79**	**C-**	**55 - 59**	**F**	**0 – 39**

Week of	Topics	Reading (pages)
Sep. 1	Course remark, Review of Chapter 1: thermodynamics	4 – 39
Sep. 6	Review of Chapter 1-3 : thermodynamics, probability, statistics, Boltzmenn, ideal gas law	35-62, 69-103
Sep. 13	Chapter 4: random walk, diffusion, friction, Einstein relation, polymer conformation, Fick's law, diffusion equation	108-135
Sep. 20	Chapter 4: Membrane diffusion, Nersy relation, **Review-Eax (Ch. 1,3, & 4)** Chapter 6: Entropy, Shannon's formula,	135-146, 195-198
Sep. 27	Chapter 6: Sackur-Tetrode, temperature, second law, open system, entropic force, free energy, microscopic systems, and Boltzmann distribution	199 – 220
Oct. 4	Chapter 6: Kinetics, partition function, 2-state-system, **Mid-Exam 1 (Ch. 4-6)** Chapter 7: Entropic forces, osmotic pressure	220-231, 245-251
Oct. 11	Chapter 7: depletion forces, osmotic flow, electrostatics, Gauss law, charged surfaces, Poisson-Boltzmann equation, double layers	251-269
Oct. 18	Chapter 7: entropic forces between charged surfaces, properties of water Chapter 8: Chemical Potentioanl, grand partition function	269-282, 294-298
Oct. 25	Chapter 8: chemical equilibrium, Gibbs free energy, reaction kinetics, ions & dissociation, amphiphiles and self-assemble	298-334
Nov. 1	Chapter 9: polymer elasticity, stretching single molecules, cooperativity	341-363
Nov. 8	Chapter 9: molecular switching, helix-coil transition, DNA 'melting', applied forces, allostery, **Mid-Eam2 (ch. 7 – 9)**	363-383
Nov. 15	Chapter 10: molecular devices in cells, enzymes, cyclic motors, energy landscapes, Smoluchowki equation,	401-432
Nov. 22 (No class Nov. 24)	Chapter 10: real mechines, Michaelis-MEnten rule, molecular motor,	432-453
Nov. 29	Chapter 11: electro-osmotic effects, ohmic conductance, Donnan equilibrium, ion pumps, mitochondria,	469-500
Dec. 6	Chapter 12: Nerve impulses, action potentials, Reviews	505-551
Final	FINAL EXAM ON DECEMBER 14TH, 10:40am ~ 1:10 pm	EVERYTHING