

**PHYS-461 & PHYS-561: BIOPHYSICS**  
**Fall Quarter: 19 September — 3 December 2011**

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**Course Objective:**

*Biophysics* is an interdisciplinary science that employs and develops theories and methods of the physical sciences for the investigation of biological systems. The undergraduate PHYS-461 & graduate PHYS-561 courses are merged into one *introductory* biophysics course. Currently, biophysics is one of the fastest growing physics research areas that is vital to many other fields, including medicine, bioengineering, and biology. There are two major ways that the biological processes are affected by physics: (i) through physical principles underlying molecular interactions and (ii) through development and application of physical methods to studies of biological systems: DNA, proteins, lipid membranes, and cells.

The topics that will be presented throughout the course include an introduction to the elementary structure of DNA, proteins, membranes, and cells, and the physical principles that govern the resulting structures. Here, the physical quantities such as temperature, energy, enthalpy, entropy, and free energy will be employed to understand why a biological system chooses particular state at conditions under study.

The problem assignments will be given weekly to both undergraduate and graduate students with extra problems for the latter. Additional homework problems and reading assignments will be given to graduate students. In addition, the midterm and final exams will include extra problems for graduate students.

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**Course Coordinator: Brigita Urbanc**

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Lectures: TUE & THU 11:00am—12:20am (DISQUE HALL, 12-919)

[Lecture 1: TUE, 09/20/2011 & Lecture 19: THU, 12/01/2011]

**Help/Office hours:** By appointment: send an e-mail request to brigita@drexel.edu.

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**Course Textbook:**

AUTHORS: Rob Phillips, Jane Kondev, and Julie Theriot

TITLE: Physical Biology of the Cell

PUBLISHER: Garland Science

YEAR: 2008, 1<sup>st</sup> Edition

ISBN-10: 0815341636

ISBN-13: 978-0815341635

**Recommended General Biophysics Textbook:**

- [1.] Philip Nelson, *Biological Physics*, W. H. Freeman, 1<sup>st</sup> Edition, 2007 (ISBN-10: 0716798972, ISBN-13: 978-0716798972).
- [2.] Daniel Goldfarb *Biophysics DeMYSTiFied*, McGraw-Hill Professional, 1<sup>st</sup> Edition, 2010 (ISBN-10: 0071633642, ISBN-13: 978-0071633642).

**Recommended Protein Physics Textbooks:**

- [A] Alexei V. Finkelstein and Oleg B. Ptitsyn, *Protein Physics: A Course of Lectures*, Academic Press (An Imprint of Elsevier Science), 1<sup>st</sup> Edition, 2002 (ISBN: 0-12-256781).
- [B] Kerson Huang, *Lectures on Statistical Physics and Protein Folding*, World Scientific Publishing Co., 2005 (ISBN: 981-256-143-9).
- [C] Thomas E. Creighton, *Proteins: Structures and Molecular Properties*, W.H. Freeman and Company, 2<sup>nd</sup> Edition, 1993 (ISBN: 0-7167-7030-X).
- [D] Bengt Nölting, *Methods in Modern Biophysics*, Springer, 2<sup>nd</sup> Edition, 2006 (ISBN-13 978-3-540-27703-3).

**Recommended Polymer Physics Textbook:**

Pierre-Giles De Gennes, *Scaling Concepts in Polymer Physics*, Cornell University Print, 1<sup>st</sup> Edition, 1979 (ISBN-10: 080141203X, ISBN-13: 978-0801412035).

**Course Requirements/Grading Information:**

Lecture attendance is obligatory. The course cannot be completed unless all required homework assignments are handed in *on time*. Graduate students will have to complete also one special topic assignment, consisting of a 5-page research paper on selected topics. The midterm and final exam will include calculus-based, problem solving questions. Four 10-minute quizzes with multiple choice type conceptual questions will be given. There will be no make-up exams or quizzes. The final letter grade will be based on the total score, obtained from the components described in Table I.

TABLE I: GRADING

Grade Components	Contribution
Homework Assignments	30%
Quizzes (a sum of four)	20%
Midterm Exam	20%
Final Exam	30%

**Important Dates:**

The last day to withdraw from the course is Friday, 10/28/2011. On the day of Drexel Convocation (TUE, 09/27/2011) and on Thanksgiving Day (THU, 11/24/2011), there are NO classes. The Midterm Exam is scheduled during the regular lecture time during Week 6 (TUE, 10/25/2011). The Final Exam will be given during the week of 12/05-12/10. The exact date and time will be announced later.

TABLE II: TENTATIVE SYLLABUS

WEEK	LECTURE	TOPIC	HOMEWORK DUE	QUIZ
Week 1: 09/20 09/22	Lecture 1 Lecture 2	The Scope and Topics of Biophysics Thermodynamics and Statistical Mechanics	N/A N/A	N/A N/A
Week 2: 09/29	Lecture 3	Ch.5: Mechanical and Chemical Equilibrium	N/A	N/A
Week 3: 10/04 10/06	Lecture 4 Lecture 5	Ch.5: Mechanical and Chemical Equilibrium Ch.6: Entropy Rules!	N/A N/A	Quiz 1 N/A
Week 4: 10/11 10/13	Lecture 6 Lecture 7	Ch.6: Entropy Rules! Ch.7: Two-State Systems	N/A HW-1	N/A N/A
Week 5: 10/18 10/21	Lecture 8 Lecture 9	Ch.8: Random Walks Ch.8: Random Walks	N/A HW-2	Quiz 2 N/A
Week 6: 10/25 10/27	Midterm Exam Lecture 10	Chs. 5-8 Ch.9: Electrostatics for Salty Solutions	N/A HW-3	N/A N/A
Week 7: 11/01 11/03	Lecture 11 Lecture 12	Ch.10: Beam Theory Ch.10: Beam Theory	N/A N/A	N/A Midterm Exam
Week 8: 11/08 11/10	Lecture 13 Lecture 14	Ch.11: Biological Membranes Ch.11: Biological Membranes	N/A HW-4	N/A N/A
Week 9: 11/15 11/17	Lecture 15 Lecture 16	Ch.12: The Mathematics of Water Ch.13: A Statistical View / Dynamics	N/A HW-5	Quiz 3 N/A
Week 10: 11/22	Lecture 17	Ch.14: Life in Crowded / Environments	N/A	N/A
Week 11: 11/15 11/17	Lecture 18 Lecture 19	Ch.15: Rate Equations and Dynamics / Cell Ch.15: Rate Equations and Dynamics / Cell	N/A HW-6	N/A Quiz 4
Week 12: TBA	Final Exam	Chs. 5-15	N/A	N/A