Physics 171.310: Biological Physics Fall 2016

Course Description: This course introduces topics of classical statistical mechanics through the study of biological systems. Additional topics include low-Reynolds number hydrodynamics and ionic solutions, via biologically relevant examples such as diffusion, entropic forces, self-assembly, membrane physics and nerve conduction. It is intended for students with an interest in biological inspired physics or the biophysical or biological sciences.

Prerequisite: Physics 171:101-102, 171:103-104; 171.105-106; 171.107-108; Calculus II 110.109.

Textbook: Biological Physics: Energy, Information, Life, Updated 1st Edition by Philip Nelson (Paperback: ISBN-10: 0716798972 or ISBN-13:978-0716798972)

The 1st Edition is also acceptable. The main thing missing is some additional problems. They will be made available as needed via Blackboard.

Recommended as general references that some find helpful now and in future:

Intermediate Physics for Medicine and Biology, 4th Edition by R. K. Hobbie and B. J. Roth (ISBN-10: 0-387-30942-X, ISBN-13: 978-0-387-30942-2)

Used Math by C. E. Swartz (ISBN-10: 0139397361, ISBN-13: 9780917853500)

Anticipated Schedule – Check Blackboard for Updates

Week 0 (Aug. 29): No lectures. Organizational section on Friday.
Week 1 (Sep. 5): Overview, statistical physics, basics of discrete probabilities
Week 2 (Sep. 12): Continuous variable probabilities, Boltzmann distribution
Week 3 (Sep. 19): Brownian motion, Friction and Diffusion
Week 4 (Sep. 26): Life at low Reynolds number
Week 5 (Sep. 28): Low Reynolds number applications
Week 6 (Oct. 3): Statistical phys.: entropy, temperature and free energy
Week 7 (Oct. 10): Statistical physics continued (Lectures Oct. 12,14 and 15 no section)
Week 8 (Oct. 17): Entropic forces
Week 9 (Oct. 24): Chemical forces
Week 10 (Oct. 31): Entropic springs
Week 11 (Nov. 7): Membrane Transport
Week 12 (Nov. 14): Ion pumping, nerve impulses
Nov. 21: Fall Break
Week 13 (Nov. 28): Nerve conduction: Hodgkin-Huxley model

Grading: The grading will be based on homework (25%), labs (5%), two midterms (15% each) and the final exam (40%). If a student's grade on the Final exam is higher than his or her average on the midterm exams, the final exam will be counted for 55% of the grade, and the student's worst midterm exam score will be dropped. It is expected that students will attend all lectures, labs, and sections, and complete all assignments, and exams.

Homework: Solving problems is the only way to learn physics. For this reason, the problem sets are probably the most important part of the course. To get the greatest benefit from the problems sets you should work on every problem yourself before discussing it with others. Subsequent collaboration can be useful and constructive, provided all parties put in equal efforts. While such collaboration is not discouraged, the final writeup must be your own. No credit will be given for homework submitted after the solutions are distributed unless you have prior authorization for a compelling reason.

Your homework should clearly indicate what steps you have taken in reaching your answer and why. Simply stating the answer is not sufficient.

Some exercises require the use of a computer. Computers and software are available in the Physics Undergraduate Computer (PUC) lab in Bloomberg 478. As a student in Physics 310, you are welcome to use this lab. Please see Brian Schriver in Bloomberg 366G (Dept. Office) for an application

form. Examples will be provided for the software package Mathematica. You may wish to install it on your own machine and can obtain a free license through the university. Those of you who are more familiar with an equivalent package like MatLab or R, may use that for your homework.

Labs: There will be periodic laboratory exercises. These will be of an informal nature, but they are instructive and perhaps even fun. Attendance and participation is mandatory, but extensive lab write-ups etc will not be required. A tentative schedule of the labs is included with the syllabus. We may have to shift the dates of one or more lab.

University-wide statement on Academic Ethics: The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful. Ethical violations include cheating on exams, plagiarism, reuse of assignments, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. As noted above, collaboration on homework sets is encouraged. However, you should attempt problems independently before collaborating and must write up your homework independently.
Report any violations you witness to the instructor. You may consult the associate dean of students and/or the chairman of the Ethics Board beforehand. See the guide on "Academic Ethics for Undergraduates" and the Ethics Board web site (http://ethics.jhu.edu/) or http://www.advising.jhu.edu/ethics.html for more information.

Homewood-wide statement on Disabilities: Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516-4720, studentdisabilityservices@jhu.