Physics 480 – Molecular Biophysics (Special Topics)

Spring 2016

COURSE MEETING TIME AND PLACE:

Meeting Time	Location
MoWeFr 10:00 – 10:50 am	Merion Science Center 103

INSTRUCTOR INFORMATION:

Dr. Shawn H. Pfeil e-mail: <u>spfeil@wcupa.edu</u> (please include course in subject line) phone: (610) 430-4084 office: Schmucker Science South 229

OFFICE HOURS:

My scheduled office hours as of the first day of class are listed below. I reserve the right to adjust this schedule to reflect unforeseen circumstances. <u>Please note homework assignments are due **Monday** at the start of class.</u>

Monday	Wednesday	Friday
11 am - 12 pm	11 am - 12 pm	11 am - 12 pm
		2 pm – 4 pm

Office hours are available by appointment for students with an ongoing conflict with my scheduled hours.

REQUIRED COURSE MATERIALS:

Our textbook:

Physical Biology of the Cell 2nd Edition, R. Phillips, J. Kondev, J. Theriot and H.G. Garcia, Garland Science (2013)

• Text website at: <u>http://microsite.garlandscience.com/pboc2/</u>

COURSE DESCRIPTION:

Physical modeling applied to the mechanics of the Cell and cellular components. This course has two main components, a brief overview of molecular biology from a physical prospective, and a more in-depth exploration of biophysical modeling. Modeling topics include when and how *equilibrium* statistical and thermal physics can be applied to *living, non-equilibrium,* systems, diffusion and random walks of molecules in solution, and as applied to modeling polymers, electrostatics in charged solutions, and models of motor proteins.

LEARNING OUTCOMES:

- Students will demonstrate a basic understanding of cell biology.
- Students will demonstrate an ability to discriminate between which elements of a biological system are relevant for modeling.
- Students will demonstrate an ability to analyze biophysical models.
- Students will demonstrate an ability to create simple biophysical models.
- Students will demonstrate an ability apply basic physical principles in a biological setting.

Course objectives will be achieved via solving and understanding problems sets. Outcomes will be assessed via in class exams and discussions.

TIME COMMITMENT AND WORK FLOW:

The life of a college student is not easy. A full time student can expect to spend about 50 hrs per week on coursework, or about 12.5 hrs per week per course. Because PHY480 is a 400 level elective, I expect that you will spend about this much time on the course per week:

Activity	Time Commitment
Reading Prior to Class	3 hrs/week
Class	3 hrs/week
Post Lecture Study	1.5 hrs/week
Homework After Lecture	5 hrs/week
Total Time Spent	12.5 hrs/week

COURSE ELEMENTS:

- <u>Pre-Class Reading</u>: You must read the assigned reading prior to class. Due to the pace of the course, we must focus our time in lecture on more challenging concepts. You are responsible for coming prepared.
- **Lecture:** Lots of questions are encouraged. This will be as informal as possible.
- **<u>Problem Sets</u>**: A problem set will be posted on D2L for each week. (Problem sets for the previous week are due on Mondays.)
- **<u>Final Project:</u>** Instead of a final exam students will complete a two component final project.
 - Final Project Paper Students will write a short paper describing a biophysical system and the models and experimental methods used to investigate it. (Detailed guidelines will be provided.) This project is meant to build on our study of a model from class, and report on the current state of research. *This is an individual assignment.*
 - Presentations students will present on a topic agreed upon with the instructor. Presentations will be individual and will last for 10 minutes with 5 minutes allowed for questions.

GRADING:

Component	Percentage	
Regular Exams	60% (Three exams @ 20%)	
Final Project Paper	15%	
Final Project Presentation	5%	
Problem Sets	20%	

- Regular Exams: Three exams spaced through-out the semester. No exam scores will be dropped.
- Final Exam: The final exam is cumulative and will occur in class on Wednesday May 4th from 10:30 am

 12:30 pm.
- <u>Problem Sets</u>: Problem sets will be collected every Monday at the start of class. Working with your peers is strongly encouraged; however any work turned in must be in your own words and represent <u>your</u> understanding of the material. Under no circumstances is it acceptable to represent someone else's work as your own. *List anyone you worked with at the start of the problem.*
- **<u>Final Projects</u>**: A detailed grading rubric will be provided for final projects.

We will be using the official WCU scale for grades, see the undergraduate catalog. However, I reserve the right to adjust the weights of individual components, or the scale to account for unforeseen circumstances.

COURSE POLICIES

Below is a listing of established course policies. Please check this list first if you have a question. If your concern is not addressed by the list below, please see me in person.

EXAM POLICY

No make-up exams will be given. If you feel you must miss an exam for a University Sanctioned Event or health related reason contact me in advance.

ELECTRONIC DEVICE POLICY:

The pace of the course is such that your undivided attention will be required for the entire lecture and lab period. Please set all electronics to silent or "vibrate mode" and put them away. Both you and your neighbors will be able to concentrate on the material at hand. *If you are using a device to record lecture, please see the intellectual property statement below.*

D2L:

D2L will be used to post problem sets, grades, and announcements. Please make sure to check D2L periodically or enable it to push announcements via e-mail.

ATTENDANCE POLICY:

I do not grade on attendance but it is crucial to success in class.

DISABILITY STATEMENT:

If you have a disability that requires accommodations under the Americans with Disabilities Act (ADA), please present your letter of accommodations and meet with me as soon as possible so that I can support your success in an informed manner. Accommodations cannot be granted retroactively. If you would like to know more about West Chester University's Services for Students with Disabilities(OSSD), please contact the OSSD which is located at 223 Lawrence Center. The OSSD hours of Operation are Monday – Friday 8:30 a.m.–4:30 p.m. Their phone number is 610-436-2564, their fax number is 610-436-2600, their email address is <u>ossd@wcupa.edu</u>, and their website is at www.wcupa.edu/ussss/ossd.

ELECTRONIC COMMUNICATIONS STATEMENT:

It is expected that faculty, staff, and students activate and maintain regular access to University provided e-mail accounts. Official university communications, including those from your instructor, will be sent through your university e-mail account. You are responsible for accessing that mail to be sure to obtain official University communications. Failure to access will not exempt individuals from the responsibilities associated with this course.

UNIVERSITY SANCTIONED EVENTS:

If you will be participating in a University sanctioned event during class or an exam **you must notify me in advance**. Please see the discussion of University Sanctioned Events in the general catalog.

INTELLECTUAL PROPERTY STATEMENT:

I, the instructor, utilize copyrighted materials under the "Freedom and Innovation Revitalizing the United States Entrepreneurship Act of 2007" (Fair Use Act). Apart from such copyrighted materials, all other intellectual property associated with this course is owned and copyrighted by the instructor, including, but not limited to, lectures, course discussions, course notes, slides, assessment instruments such as exams, and supplementary materials posted or provided to students authored by the instructor. No recording, copying, storage in a retrieval system, or dissemination in any form by any means of the intellectual property of the instructor, in whole or in part, is permitted without prior written permission of the instructor. When such permission is granted, it must specify the utilization of the intellectual property and all such permissions and waivers shall terminate on the last day of finals of the semester in which this course is held.

ACADEMIC INTEGRITY & CONDUCT

I have a zero tolerance policy for breaches of academic integrity. Breaches of academic integrity will be investigated and sanctions imposed to the full extent available under University policy. For questions regarding the university Academic Dishonesty, the No-Grade Policy, Sexual Harassment, or the Student Code of Conduct, students are encouraged to refer to their major department's handbook, the Undergraduate Course Catalogue, the Rams Eye View, or the University Web

Site. Please understand that improper conduct in any of these areas will not be tolerated and may result in immediate ejection from the class.

ALL OTHER ACADEMIC POLICIES

For any university wide academic policy not explicitly covered in this document, such as No Grade policies. Please consult your major advising handbook, the Undergraduate Catalog, the Ram's Eye View, or the University Website.

PUBLIC SAFETY

The Emergency Communications Committee recommends that the number of WCU's Department of public safety be available on every course syllabi. WCU Department of Public Safety: (610) 436-3311.

COURSE SCHEDULE: Please note schedule is subject to change..

Date	Day	#	Торіс	Chapter:
01/20	W	1	Introduction, Biology by the Numbers	1
01/22	F	2	E. coli	2.1
01/25	М	3	Eukaryotic Cells and Viruses	2.2
01/27	W	4	Finish Cells & Multicellular Organisms	2.2-2.3
01/29	F	5	Time dependence & procedural time	3.1-3.2
02/01	М	6	Relative time	3.3-3.5
02/03	W	7	Model Systems: Hemoglobin & Phages	4.1-4.3
02/05	F	8	Model Systems: E. coli & Yeast	4.4-4.5
02/08	М	9	Model Systems: Flies, Mice, & Squid	4.7-4.9
			End of Molecular Biology Background	
02/10	W	10	Energy Budget of the Cell	5.1-5.4 (Read 5.3)
02/12	F	11	Free-Energy, Entropy, and Entropic Forces (intro)	5.5
02/15	M	12	The Boltzmann Distribution and Ligand Binding	6.1
02/17	W	13	The Boltzmann Distribution and Information Theory	6.2
02/19	F	14	Chemical Potential, Osmotic Pressure, Equilibrium Constants	6.2-6.3
02/22	М	15	The Hill Equation, Power Available from ATP	6.4-6.5 7.1-7.2
02/24	W	16	Internal States of Molecules: Ion Channels and Binding	7.2
02/26	F	17	Internal States of Molecules: Phosphorylation and Singnal Transduction	
02/29	М	18	Hemeglobin and Cooperativity	7.2
03/02	W	19	The Monod-Wyman-Changeux Model (MWC)	7.3
03/04	F		EXAM 1 (Chapters 1-6)	
	MWF		03/07/2016-03/11/2016 SPRING BREAK	
03/14	М	20	Random Walk Models Of Polymers I: FJC and Gaussian Chains	8.1-8.2.1
03/16	W	21	Random Walk Models of Polymers II: Examples	8.2.1-8.2
03/18	F	22	Single-Molecule Force Spectroscopy and Force Extension Curves	8.3
03/21	М	23	Proteins as random walks and protein folding	8.4
03/23	W	24	pH and the charge of DNA and proteins	9.1-9.2
03/25	F	25	Electrostatics of Salty Solution, Screening, and Poisson-Boltzmann	9.3
03/28	М	26	Beam Theory: Energetics of Beam Deformation, Feynman Diagrams?	10.1-10.2
03/30	W	27	Mechanics of Translational Regulation and DNA looping and applications	10.3-10.4
04/01	F		Exam 2 (Chapters 7-9)	
04/04	М	28	Structural prospective of the cell	10.5-10.6
04/06	W	29	Diffusion and active transport	13.1-13.2
04/08	F	30	Smoluchowski Equation, Einstein Relation, Diffusion Limited Reactions	13.213.3
04/11	М	31	Rate Equations I: Statistical Dynamics	15.1-15.2
04/13	W	32	Rate Equations II: Enzymes and Michaelis-Menton	15.2-15.3
04/15	F	33	The Cytoskeleton and Dynamic Instability	15.4-15.5
04/18	М	34	Molecular Motors Introduction	16.1
04/20	W	35	Molecular Motors: Walkers	16.2
04/22	F	36	Molecular Motors: Polymerization Motors	16.3
04/25	М	37	Run over/Snow Day/TBA	
04/27	W	38	Exam 3 (Chapters 10, 13, 15, 16)	
04/29	F	39	Run over/Snow Day/TBA	
05/02	М		Student Presentations (also during final period.)	