York University
BPHS 3090: Biophysics I (3 credits)
Winter 2015

Time & Location

Lecture: MWF 9:30-10:30 (Bethune College, BC 225)

Instructor: Christopher Bergevin
Office: Petrie 240
Email: cberge@yorku.ca
Office Hours: Check course website (or email for appt.)

Course Website:

`http://www.yorku.ca/cberge/3090W2015.html`

Textbook:

Cellular Biophysics, vol. I & II, TF Weiss (*MIT Press*)*.

Prerequisites: SC/BPHS 2090 2.00; SC/PHYS 2020 3.00; SC/PHYS 2060 3.00

Course Theme/Topics: This course will generally focus on the topic of cellular transport to examine the interplay between physics and the life sciences. Topics will include (but are not limited to):

- Diffusion
- Osmosis
- Carrier-mediated transport
- Ion channels
- Modeling cell membranes using electric circuit analogs
- Action potentials (e.g., Hodgkin Huxley model)
- Fluid motion at cellular dimensions (laminar flow, low Reynolds number)

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*The York U library has a copy. Another text that may be a useful reference for the course (though not necessarily recommended to purchase) is *Intermediate Physics for Medicine and Biology*, 4th Ed., R. Hobbie & B. Roth (*Springer*). This book can be downloaded for free as a pdf via the York University library (ask course instructor for details)

Course Policy

Grading

There will be 100 total possible points in the course. Point breakdowns are as follows:

- Homework – **25 points**
- Exams – **50 points**
- Project – **25 points**

Final grades will be no lower than as listed below:

$90 <$ points (90%-100%) = A+
$80 <$ points (80%-89%) = A
$75 <$ points (75%-79%) = B+
$70 <$ points (70%-74%) = B
$65 <$ points (65%-69%) = C+
$60 <$ points (60%-64%) = C
$55 <$ points (55%-59%) = D+
$50 <$ points (50%-54%) = D
~ 50 points ($\sim$50%) = E
points < 50 (0%-50%) = F

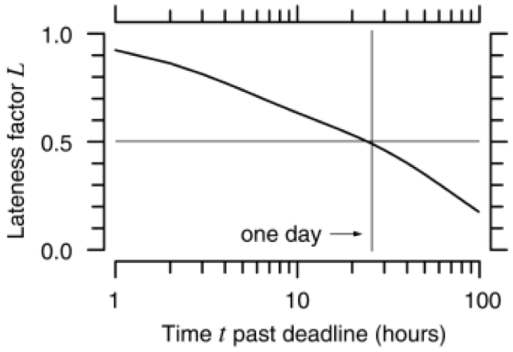
Homework: Assignments will be given on a regular basis (there will be $\sim$7–8 assignments). Each student is expected to turn in his or her own assignment. Points may be deducted for lack of explanation/clarity/completeness. It is crucial for students to spend considerable effort on these problem sets in order to be successful in the class.

Exams: Two exams will be given in class, the first on Friday **Feb. 27** and the second during the assigned 3090 final exam time (TBD). Note, as specified in the *lateness policy* below, there are no makeups.

Project: By the end of BPHS 3090, students will have have learned about a number of topics that will contribute to a deep understanding of the mechanisms underlying neurodynamics. Towards this end, there will be a *project* component to the course that will consist of two separate parts.

- *Critical literature review/discussion* (40%) – A current research paper will be chosen and distributed to the class. Everyone will be expected to read the paper and write up a short one-page document that a. summarizes the key theme of the paper, b. identifies key biophysical themes present, and c. poses several probing questions stemming from it. Furthermore, one class session will be dedicated to a critical discussion of that paper and everyone will be required to participate and contribute significantly to the discussion.
- *HH Simulations* (60%) – Students will use (Matlab-based) software that allows them to simulate the Hodgkin-Huxley model for action potentials. Given the complexity of the HH model and the large number of parameters, a wide array of interesting behavior can be observed from the model. As such, students will be asked to create a testable hypothesis that they will then use the software to address. Students will also be asked to give a short presentation in class on their hypothesis/results.

Lateness: Unfortunately, some deadlines in the *real world* are quite harsh and allow no room for lateness. Given such, this course will implement two policies:



1. **There will be no makeup exams**. It is very important that you are present in class for the exams and the project presentation (as these determine more than 75% of your final grade!). Exceptions in extreme cases may be granted, but only upon prior approval or for an (excused) emergency.

2. All other due dates (i.e., for HW, lab reports, and project deadlines) will be subject to a severe lateness penalty. The grade for a particular assignment will be multiplied by a lateness factor

$$L = 0.3e^{-t/4} + 0.7e^{-t/72}$$

where t is the number of hours late. See figure for the lateness factor plotted as a function of time. Notice that the maximum grade for a report that is more than ONE DAY LATE is less than 50%.

Course Computing

As this is a 3rd year physics course, one objective will be that by the end of the semester students are comfortable using a computer in a variety of fashions. Towards this end, you will be encouraged to use Matlab[†] in a number of different ways. Two specific themes towards this end will be woven into the course:

1. *SoftCell* – A program developed at MIT that is freely available (we will provided a semi-updated version via the 3090 course website), which allows for a wide variety of simulations to be run that are relevant to the course topics. Exercises using this software will be woven into the HW assignments.

2. *Programming* – To avoid computers becoming *black boxes*, you may be asked to write some simple codes to perform tasks relevant to course topics (e.g., write a code to numerically solve a differential equation). Exercises along these lines will be woven into the HW assignments.

The course instructors will be happy to help out with any difficulties along either of these lines. So don't be afraid to ask for help!

Academic Honesty and University Attendance Policies

[†]Matlab is accessible via the York library computers and can also be downloaded for use on PCs. A free version of the software also exists and is called *Octave*.

Students are responsible to be informed of University policies:

http://www.yorku.ca/secretariat/policies/index-policies.html

Regarding the Academic Honesty, students found to be in violation of the Code are subject to sanctions that will be determined by the severity of the infraction. The Code of Academic Integrity will be enforced in all areas of the course, including projects, tests, and homework. For assignments (e.g., HW, labs), students can (and are encouraged to) work together in groups. However, each student will be expected to turn in their own individual assignments and (reasonably) acknowledge contributions made by others.

Students are expected to attend every scheduled class and be familiar with the University Class Attendance policy. It is the student's responsibility to keep informed of any announcements, syllabus adjustments, or policy changes made during scheduled classes. Students may be administratively dropped if they miss more than three classes and/or the first class.

Classroom Conduct

Students at York University are expected to conform to the standards of conduct established in the Code of Student Rights and Responsibilities. Prohibited conduct includes:

1. All forms of student academic dishonesty, including cheating, fabrication, facilitating academic dishonesty, and plagiarism.
2. Interfering with University or University-sponsored activities, including but not limited to classroom related activities, studying, teaching, research, intellectual or creative endeavor, administration, service or the provision of communication, computing or emergency services.
3. Endangering, threatening, or causing physical harm to any member of the University community or to oneself or causing reasonable apprehension of such harm.
4. Engaging in harassment or unlawful discriminatory activities on the basis of age, ethnicity, gender, handicapping condition, national origin, race, religion, sexual orientation, or veteran status, or violating University rules governing harassment or discrimination.

$\rightarrow$ Students found to be in violation of the Code are subject to disciplinary action.

Students Who Require Reasonable Accommodations Based on Disability

Students planning to use accommodations for this course should privately identify themselves to their instructor within the first few days of class.

2015 Important Dates

First Day of Class . . . . . Jan. 5, 2015
Reading Week . . . . . Feb. 14-20 (**no classes**)
First Exam . . . . . Feb. 28
Student HH presentations . . . . . Mar. 25 (tentative)
In-class paper discussion . . . . . Mar. 30 (tentative)
Good Friday . . . . . Apr. 3 (**no class**)
Last Day of Class . . . . . Apr. 6