Syllabus
Biological and Medical Physics
PHY 315 - Spring 2016

Instructor:
Dr. Martin B. Forstner, E-mail: mbforstn@syr.edu, Office: Rm. 217 in the Physics Building

Office hours:
Right after class or by appointment; the best way to contact me outside of class is by e-mail.

Course Webpage:
Materials for this class are posted on Blackboard.

Prerequisites:
PHY 212 or PHY 216

Course description:
This is a 3 credits course for undergraduate students from physical and biochemical sciences and engineering. This course deals with the most fundamental concepts of physics and how they manifest in biological systems. You will learn how the quantitative, physical approach can help to obtain a better understanding of the most basic mechanisms of living systems. All subjects studied in this class will be pertinent to the processes at the molecular and cellular levels. It is critically important that you realize that this is a truly advanced interdisciplinary class for undergraduate studies. The PHY 315 class will employ some background in mathematics, including differential and integral calculus.

Course objectives:
- To build up basic knowledge of the physical and biological principles of processes in a living cell
- To acquire fundamental concepts of the biology and chemistry of cellular systems
- To understand the underlying connections between these principles
- To obtaining a comprehensive understanding of the quantitative aspects of cellular life processes
- To gain general information about some of the most recent developments in cellular biophysics
- To explore biological problems by employing quantitative models
- Obtaining an understanding of the fundamental principles used in medical physics.
- To develop qualitative and quantitative problem solving skills

Contents of the class:
- Why Biology by the numbers?
- Design schemes of biomolecules, cells and organisms
- Understanding water: Its physics and important role in living systems.
- Design schemes of biomolecules, cells and organisms
- Biological membranes
- Time and length scales in biological systems.
- Mechanical and chemical equilibrium in the living cell
- What is entropy and why does it matter?
- From the on-off switch to the Boltzmann distribution
- A statistical view of biological dynamics
- Rate equations and dynamics in the cell
- Dynamics of molecular motors
Lectures:
We will meet twice a week: Tuesdays and Thursdays, 5:00 – 6:20 P.M. Lectures will be held room 104N in the Physics Building. It is important that you come, attend and participate actively in the lectures. Class participation, through questions and discussions, is highly encouraged. We will introduce new ideas and concepts, and then demonstrate them by both conceptual problems and applications.

Textbook:
“Quantitative Understanding of Biosystems – An Introduction to Biophysics” by Thomas N. Nordlund, CRC Press, Taylor & Francis Group, Boca Raton, 2011; this is a great textbook for learning the fundamentals of biological physics at the advanced undergraduate level. We will follow the book very closely. Students must use this textbook to supplement their lecture notes.

Exams:
There will be 3 equally weighted, non-comprehensive exams. Two of them will be given during the time and in the place normally scheduled for the lecture. The third will take place during the scheduled time for the final of this class. The exams will cover the material discussed in class, assigned readings, and the material covered in homework. Exam problems and questions will be in the same style as those assigned for homework. They may contain both short essay-type questions on the biology material and calculation-based problems on the more physical material and vice versa. In general, no make-up exams will be given.

Exam Schedule:
Exam 1 on Monday February the 12th covering classes 2-10
Exam 2 on Monday March the 24th covering classes 11-20
Exam 3 on April the 30th at 5:15 covering classes 22-30

Homework:
The homework assignments will typically be distributed weekly on Thursdays. Homework will be normally due on Thursdays of the following week. Detailed solutions to the homework will be posted after the lecture they are due.

Make-up Policy:
Should you miss a quiz or examination due to illness or an emergency, appropriate make-up arrangement can be made. Please, keep in mind that solid documentation such as a doctor’s note is needed in order to justify such special treatment.

Grading Policy:
You will be evaluated, based upon your performance in the class, as follows:

<table>
<thead>
<tr>
<th>Component</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Homework</td>
<td>20%</td>
</tr>
<tr>
<td>Exam</td>
<td>70%</td>
</tr>
<tr>
<td>Class Participation</td>
<td>10%</td>
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</tbody>
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The lowest homework grade will be dropped!
General tips for making PHY 315 a success:

Many lectures will build on previous material. This rule does not deviate from the general way in which scientific knowledge builds. For this reason, it is important not to fall behind.

Here is a recipe for making PHY 315 a success:

- **Set aside time to study!** Student surveys state that the average student spends six hours per week working on this course, outside of class. This number should be higher. You will do yourself a favor by scheduling at least 8 hours per week outside of class time, and sticking consistently to that schedule.

- **Attend the lectures!** The purpose of the lectures is to introduce new concepts and to relate them to others. These connections are important. You need to identify these connections, and use them when necessary. If you simply memorize techniques to solve problems, then you will find Biological Physics to be an enormous and disconnected subject. On the other hand, if you learn to think of biological physics as governed by just a few rules (e.g., the conservation of mass, charge and energy), then you will find PHY 315 to be not only manageable, but also enjoyable.

- **Do the homework!** Lectures and study assignments set the stage. But only by answering questions and effectively solving the problems and conceptual examples does deep understanding arrive. Get help early and often. Falling behind will only make your everyday life with PHY 315 harder.

Academic Integrity:

Syracuse University’s Academic Integrity Policy holds students accountable for the integrity of the work they submit. Students should be familiar with the policy and know that it is their responsibility to learn about course-specific expectations, as well as about university policy. The university policy governs appropriate citation and use of sources, the integrity of work submitted in exams and assignments, and the veracity of signatures on attendance sheets and other verification of participation in class activities. The policy also prohibits students from submitting the same written work in more than one class without receiving written authorization in advance from both instructors. The presumptive penalty for a first offense by an undergraduate student is course failure, accompanied by a transcript notation indicating that the failure resulted from a violation of Academic Integrity Policy. The standard sanction for a first offense by a graduate student is suspension or expulsion. For more information and the complete policy, see [http://academicintegrity.syr.edu/academic-integrity-policy/](http://academicintegrity.syr.edu/academic-integrity-policy/)

Disability-Related Accommodations:

If you believe that you need accommodations for a disability, please contact the Office of Disability Services (ODS), [http://disabilityservices.syr.edu](http://disabilityservices.syr.edu), located in Room 309 of 804 University Avenue, or call (315) 443-4498, TDD: (315) 443-1371 for an appointment to discuss your needs and the process for requesting accommodations. ODS is responsible for coordinating disability-related accommodations and will issue students with documented Disabilities Accommodation Authorization Letters, as appropriate. Since accommodations may require early planning and generally are not provided retroactively, please contact ODS as soon as possible.

Religious Observances Policy:

SU religious observances policy, found at [http://supolicies.syr.edu/emp_ben/religious_observance.htm](http://supolicies.syr.edu/emp_ben/religious_observance.htm), recognizes the diversity of faiths represented among the campus community and protects the rights of students, faculty, and staff to observe religious holidays according to their tradition. Under the policy, students are provided an opportunity to make up any examination, study, or work requirements that may be missed due to religious observance provided they notify their instructors before the end of the second week of classes. For fall and spring semesters, an online notification process is available through MySlice/StudentServices/Enrollment/MyReligiousObservances from the first day of class until the end of the second week of class. Arrangements for the make-up work will be made in consultation with the instructor.