

# PHYS 102: Introductory Physics for Life Sciences

## Fall 2017

**Location:** Trexler 372

**Instructor:** Jarrett L. Lancaster

**Office Hours:** MWF 12:00–13:00, Tue/Thu 13:00-14:30

**Time:** MWF 09:40-10:40

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**Text:** F. R. Hallet, J. L. Hunt, R. H. Stinson, E. McFarland, G. Renninger and D. Sullivan, *Physics for the Biological Sciences*, 4th ed., Nelson, 2003.

**ISBN:** 0176224513 / (978-0176224516)

**Prerequisites:** None

## Course Description

This course provides an overview of topics in physics that are of particular importance to the life and medical sciences. The course is non-calculus based and covers mechanics (units, motion, biomechanics, energy), electricity and magnetism, heat, atomic and nuclear physics, fluids, waves, and instrumentations, all in the context of biological systems.

## Why Is This Course Important?

Admittedly, many of you do not plan to use physics directly in your future careers. This does not mean that putting in the significant effort required to master this material is a waste of your time—quite the opposite. The development of Newtonian mechanics represents one of the greatest intellectual achievements of human beings. Taking the plunge to understand this framework is a valuable lesson in problem solving, which is a *very* portable skill. Wherever you find yourself, there will be problems requiring the type of critical thinking one develops in a careful study of physics.

## Goals

At the end of the course, successful students will:

- Identify underlying physical phenomena within the biological and chemical realm.
- Parse pertinent numerical information from superfluous within contextual physics problems.
- Attach and manipulate units as a viable source of knowledge about the physical world.
- Construct organized problem solutions that demonstrate logically connected steps of thought.
- Synthesize numerical information, physical assumptions, and previous concepts to correctly solve physics problems.

- Apply analytical thinking and physical modeling to other scientific arenas.

## Attendance

We will regularly work problems, discuss, and take quizzes within the class hour, which will provide an opportunity to highlight a student's absence. Due to the mathematically rigorous nature of the course, you may not miss more than four classes without a legitimate excuse (court, hospital, police, etc.). **Late arrivals greater than 5 minutes will constitute an official absence. A fifth unexcused absence will result in a automatic drop (DF) from the course.**

## Evaluation

### Exams

All exams will contain comprehensive material from the previous chapters, likely the most missed problems from the previous exam/quizzes. Make-up exams will **only** be allowed in extreme circumstances and as a result of a discussion with me beforehand (with *very* compelling reason) or in emergency situations (death, hospitalization, court, etc.). The exam dates are:

- Exam 1: September 22, 2017
- Exam 2: October 27, 2017
- Exam 3: December 1, 2017
- Final Exam: December 13, 2017 (08:30–11:30)

### Quizzes

Weekly quizzes (typically on Friday) are completed individually in class and graded. They will consist of one problem from the homework and/or class discussion, which contain the more important concepts and/or phenomena.

### Homework

Homework will be graded for accuracy and must be turned in at the beginning of the class during which it is due (see schedule below). **No late work is accepted.** Each question (or part) is worth two points with partial credit possible when the final answer is incorrect but the overall reasoning employed is mainly correct. Graded problem sets will be returned no later than one week after the due date, and I will make every attempt to return them sooner than this.

### Labs

You **must** be enrolled in the laboratory portion (PHYS 102L) in addition to the current course. PHYS 102L operates as a separate course, but it counts as 25% of the course grade for PHYS 102. Please see the laboratory syllabus for the policy on late labs. You must complete all labs by the end of the

semester. **If any lab is not completed by the end of the semester, your course grade will be reduced by one whole letter grade.**

**Important note:** The lab session during this first offering of PHYS 102 is closely tied to PHYS 103 –the first semester in a traditional two-semester sequence. Some material covered in lab will not be covered in our course, and the order of topics which *are* covered in this course might differ from the order in which they appear in lab. Handouts will be made available to you prior to each lab section which connect where we are in class with each week’s lab topic. I will work closely with lab instructors to ensure the friction between lab topics and our schedule is as minimal as possible.

## Reflection

Toward the end of the semester, you will be asked to turn in a reflection essay about how the material in this course is relevant to your desired degree. More information about this assignment will be provided to you before Fall Break.

## Grading

Your grade will be determined from the following formula:

30% Three midterm exams (10% each)

25% Lab

15% Final exam

15% Homework

10% In-class work/quizzes

5% Reflection essay

The following grading scale will be employed:

A	93-100	B	83-86.9	C	73-76.9	D	63-66.9
A-	90-92.9	B-	80-82.9	C-	70-72.9	D-	60-62.9
B+	87-89.9	C+	77-79.9	D+	67-69.9	F	<60

Extra credit is available for students who attend a talk in the MCSP Conversation Series (schedule available at <http://cs.roanoke.edu/MCSPSeries>) and submit a well-written reflection on the talk. The requirements for the submission are:

1. a brief summary of the key ideas of the talk
2. a vivid description of the parts of the presentation that were interesting, confusing and relevant to this course
3. an overall critique of the presentation, and (if appropriate) the content Your submission must be typed, double-spaced, between one and two pages in length and employ proper grammar. Each student may submit up to two such papers during the semester, and each paper will earn 0, 1, or 2 points to be added to your final grade. **Note: a simple summary of the talk is not sufficient to receive credit.**

## **Additional Policies**

### **Academic Integrity**

I will follow the college Academic Integrity (AI) policy, and you are responsible for knowing and following the college policy as well. General concepts related to homework exercises may be clarified through conversations with other students, but you should solve the problems on your own. If I become aware of a possible violation of these guidelines, I am obligated report it to the Academic Integrity committee. The full AI policy can be found online at:  
<http://roanoke.edu/A-Z Index/Registrar/Policies and Information/Academic Integrity.htm>

### **Late Work Policy**

The course material builds upon itself, so it is important for you to receive rapid feedback on your work. Answers to homework questions will be available immediately after the due date. If you have an illness or excused absence which prevents you from completing work, and notify me before this due date comes to pass. If you have a compelling reason to miss an exam, please inform me as soon as possible. If your test absence is unexcused, you will receive a zero on the missed test. There are no makeup exams, but in the very rare case of excused absences the final exam grade can be substituted for any one missed exam.

### **Disability Support Services**

The Office of Disability Support Services, located in the Good-Pasfield Center for Learning and Teaching in Fintel Library, provides reasonable accommodations to students with identified disabilities. Reasonable accommodations are provided based on the diagnosed disability and the recommendations of the professional evaluator. In order to be considered for disability services, students must identify themselves to the Office of Disability Support Services. Students requesting accommodations are required to provide specific current documentation of their disabilities. Please contact Ms. Joann Stephens-Forrest, Coordinator of Disability Special Services, by phone at (540) 375-2248 or by email at [stephens@roanoke.edu](mailto:stephens@roanoke.edu).

### **Use of Electronic Devices**

In class, you may use personal laptops and tablets, but only for the purpose of taking notes. All other electronic devices must be turned off. On tests, you may use a scientific calculator; all other electronic devices must be turned off and out of sight. **Violation of this policy on tests will be treated as a violation of the Academic Integrity policy.**

### **Proposed Schedule**

The following schedule outlines the timeline for the topics to be covered and highlights the reading for which you are responsible. Also pay close attention to the timing of exams and assignments. **You should expect to spend at least 12 hours inside and outside of class each week on this course.**

Day	Unit	Topic	HW Due	Reading
30 Aug	1: Role	Units, Models: Physics in Biology		buy book
1 Sep	1	Scope and limitations of science		Feynman I-3
4 Sep	2: Motion and Rates	Speed (displacement rate)		7.1, 7.2
6 Sep	2	Acceleration (velocity rate)		7.3
8 Sep	2	Vectors, directionality		notes, 7.4
11 Sep	2	Kinematics odds and ends	HW1	7.5
13 Sep	2	Force (momentum rate)		8.1-8.4
15 Sep	3: Energy	Power (energy rate)		8.5-8.7
18 Sep	3	Types of energy	HW2	8.7, 9.6
20 Sep	3	Transformations of energy		14.1, 14.2
22 Sep	<b>Exam 1</b>	<b>Units 1-2</b>		
25 Sep	3	Open/closed systems; heat and entropy		14.6-14.7
27 Sep	3	Simple harmonic oscillation		1.2
29 Sep	3	Rotational/vibrational energy		9.5-9.7
2 Oct	4: Fluids	Density and pressure	HW3	11.1-11.2, 11.4
4 Oct	4	Buoyancy, drag forces		11.3, 12.1- 12.4
6 Oct	4	Reynolds number		12.5, 12.8
9 Oct	4	Propulsion	HW4	12.9
11 Oct	4	Concentration gradients, diffusion		13.7-13.8
13 Oct	4	Simple harmonic oscillation		notes
16 Oct		<b>Fall Break</b>		
18 Oct		<b>Fall Break</b>		
20 Oct		<b>Fall Break</b>		
23 Oct	5: Atomic Physics	Particles and charges	HW5	15.1
25 Oct	5	Atoms, molecules, ions		15.2-15.3
27 Oct	<b>Exam 2</b>	<b>Units 3-4</b>		

30 Oct	5	Photons, atomic energies		4.2-4.4
1 Nov	5	Electromagnetic energy		16.3
3 Nov	5	Electrochemical energy	HW6	4.5-4.7, 4.11
6 Nov	6: Instruments	Microscopy/optics		notes
8 Nov	6	TEM/SEM		notes
10 Nov	6	Optical tweezers, laser phenomena	HW7	notes
13 Nov	6	Spectroscopy		notes
15 Nov	6	IR Spec		notes
17 Nov	6	Mass Spec	HW8	notes
20 Nov	6	UV/Vis Spec		notes
22 Nov		<b>Thanksgiving</b>		
24 Nov		<b>Thanksgiving</b>		
26 Nov	6	Nuclear phenomena	HW9	notes
29 Nov	6	NMR/MRI		notes
1 Dec	<b>Exam 3</b>	<b>Units 5-6</b>		
4 Dec	6	PET/proton therapy		notes
6 Dec	6	Electrophoresis		notes
8 Dec		REVIEW	HW10	
<b>13 Dec</b>	<b>Final Exam</b>	<b>8:30-11:30</b>		

Note: "Feynman V-x" refers to chapter x in volume V of the Feynman lectures on physics, available freely at <http://www.feynmanlectures.caltech.edu/>. For instance, Feynman I-3 is chapter 3 of volume I.