PHYS 104: Fundamental Physics II

Spring 2018

Location: Trexler 372 **Time:** MWF 08:30-9:30

Instructor: Dr. Jarrett L. Lancaster **Email:** jlancaster@roanoke.edu

Office Hours: MWF 10:30–11:30, Thu 11:00-12:00, also by appointment **Office:** Trexler 264B

Text: Randall D. Knight, Brian Jones and Stuart Field, *College Physics: A Strategic Approach*, 3rd ed., Pearson, 2014.

ISBN: 978-0321879721

Note on textbook: Students who recently took PHYS 103 at Roanoke College will already have (some edition of) the Knight text. For students who previously took PHYS 102, I *strongly encourage* you to purchase an *older edition* to save on costs. You can likely acquire a usable copy of the second edition for less than $20 from online vendors. **Prerequisites:** PHYS 103 or PHYS 102

Other required materials: You will likely want to have a *working* scientific calculator for in-class assignments and exams. There also are numerous online resources you might find helpful such as Khan Academy (https://www.khanacademy.org) and MIT OpenCourseware (https://ocw.mit.edu).

Course Description

The second half of a full-year elementary physics course, using trigonometry (but not calculus) with emphasis on biological applications of physics. Topics to be discussed include electrostatics, basic DC circuitry, geometric/wave optics and elements of quantum theory.

Why Is This Course Important?

With a hearty semester of basic physics under our belts, we are now undertaking a complete and systematic study of electromagnetism–one of the four fundamental forces in nature. While you might initially feel that the only overlap between this subject and your everyday life is flipping on the light switch or mindlessly playing with magnets, we will see that electromagnetism is responsible for everything from light to the normal force provided by the ground which keeps you from falling through the floor. By developing a quantitative description of the theory of electromagnetism and exploring its consequences, you will gain a deep appreciation for how numerous seemingly unrelated phenomena can be explained by a simple set of a few rules.

Goals

Upon successful completion of the course, students will be able to:

- Identify relevant physical principles which underlie the dynamics of real-world situations.
- Parse pertinent numerical information from superfluous within contextual physics problems.

- Manipulate units as a viable source of knowledge about the physical world.
- Construct organized physical analyses that demonstrate logically connected steps of thought.
- Synthesize numerical information, physical assumptions, and previous concepts to correctly describe physical systems.
- Apply analytical thinking and physical modeling to other scientific arenas.

Most importantly, your goal is **not** to memorize equations or particular problems. The subject is difficult, and anyone who tells you otherwise is being dishonest with you (or him/herself). As an exam approaches, you might be tempted to put most of your effort into simply memorizing as many solutions as your mind can handle. This is counterproductive, and it will only lead to frustration. **Relevant equations are provided on all exams** because it is a waste of time to memorize formulas when the act of learning takes place through *using* these formulas.

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.**

Method of Instruction

You can only learn physics by falling down and learning how to pick yourself up again. At times it can be painful, embarrassing and frustrating–just like most worthwhile endeavors that lead to personal growth. To mitigate these challenges, the course is structured so that you have ample opportunities to practice your newly learned analytical skills before the stakes become high. These stages are briefly summarized as:

1. Pre-class reading

There is assigned reading in the textbook before every class meeting (except for day one and exam days). It is extremely important that you complete these readings. The goal is not to gain a deep understanding of every new concept, as this simply cannot be done by passively reading a textbook. Rather, this is initial immersion into the ideas and terminology. You should make every attempt to gain as much as you can from these readings, but do not feel that you are supposed to understand everything after a first pass. If you

2. Class time

Your responses will help to guide a brief synopsis of the main topics for each day of class. I won't cover everything contained in those readings, but just the unifying concepts and how they relate to

topics we have already encountered. The remainder of the class will be spent tackling conceptual questions and more-involved examples, which will require you to think individually and discuss your reasoning with your fellow students.

3. Homework

Your homework will consist of **daily assignments** to be turned in for grading the next class. Since the homework assignments are frequent, they will be short, often consisting of 1-2 exercises which make use of the material discussed in the preceding period. The secret to success in this course is devoting enough time to make a serious attempt at all homework exercises.

4. Pre-exam practice

A week before each exam, I will post a sample exam from a previous semester. Your exam will **not** be a carbon copy of this old exam, but it should give you an idea of the level of mastery expected. Answers to the sample exam will also be posted on Inquire.

Evaluation

Exams

There will be three mid-term exams and a cumulative final exam. Exams will include multiplechoice questions as well as questions involving written solutions. The exam dates are:

- Exam 1: February 9, 2018
- Exam 2: March 16, 2018
- Exam 3: April 11, 2018
- Final Exam: May 1, 2018 (08:30–11:30)

You will be supplied with a list of equations for each exam, which will be made available to you no later than during class preceding the exam. Use of a scientific calculator on the exams is allowed. Make-up exams will **only** be allowed as a result of a discussion with me beforehand (with *very* compelling reason) or in emergency situations (death, hospitalization, court, etc.).

Homework

A small set of exercises is assigned each day except for exam days. Unless otherwise notified, these will be due at the beginning of the next class period. Each assignment will consist of 1-2 textbook exercises and will be graded. To avoid excessive confusion for students with older editions of the text, I will post scans of the textbook exercises on Inquire. In addition to the required exercises, I will suggest a number of other exercises for further practice.

In-class assignments

Handouts corresponding to each unit we cover will be issued in class. These handouts will contain a brief summary of the relevant principles as well as several exercises. Roughly half of each class will be devoted to solving these problems in groups with instructor assistance. I reserve the right to ask that you turn in classwork for a quiz grade on any given day, and you will be notified of this before you begin working.

Quizzes

To encourage regular pre-class reading, unannounced quizzes may occur during any class. Such quizzes will be either conceptual in nature, leaning strongly on the definitions of terms discussed in the lecture/textbook, or they will involve a very short calculation which makes use of recently discussed principles. Expect a minimum of one quiz per week.

Lab

You **must** be enrolled in the laboratory portion (PHYS 104L) in addition to the current course. PHYS 104L operates as a separate course, but it counts as 25% of the course grade for PHYS 104. Please consult the lab course syllabus for information on the lab grade. **If any lab experiment is not performed by the end of the semester, your course grade will be reduced by one whole letter grade.** Also, **LAB DOES NOT MEET DURING THE FIRST WEEK OF CLASSES**.

Grading

Your grade will be determined from the following formula:

30% Three midterm exams (10% each)
25% Lab
20% Final exam
15% Homework
10% In-class work/quizzes
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 **within one week of the presentation**. 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; not every talk is directly relevant, but you should recognize this and comment accordingly

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 added to the final grade. Email your submissions to jlancaster@roanoke.edu.

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. Online responses to required readings must be completed individually. General concepts related to WebAssign 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 WebAssign problems 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. Makeup exams are only given in the most extreme situations, but the final exam grade may be substituted for a missed exam due to an excused absence. If your missed exam is unexcused, you will receive a zero on the missed test.

Special Services

Accessible Education Services (AES) is located in the Goode-Pasfield Center for Learning and Teaching in Fintel Library. AES provides reasonable accommodations to students with documented disabilities. To register for services, students must self-identify to AES, complete the registration process, and provide current documentation of a disability along with recommendations from the qualified specialist. Please contact Dr. Sue Brown, Director of Academic Services and Acting Coordinator of Accessible Education Services, at 540-375-2247 or by e-mail at sbrown@roanoke.edu to schedule an appointment. If you have registered with AES in the past and would like to receive academic accommodations for this semester, please contact Dr. Brown at your earliest convenience to schedule an appointment.

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.**

Tentative 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	Chapter	Topic	Pre-class reading
15 Jan		Overview	
17 Jan	16	Standing waves	16.1–16.4
19 Jan	16	Interference	16.5–16.7
22 Jan	20	Charge and Coulomb's law	20.1–20.3
24 Jan	20	Electric fields, conductors	20.4–20.6
26 Jan	20	Forces, energy	20.7-21.1
29 Jan	21	Electrostatic potential	21.1–21.3
31 Jan	21	Fields and potentials	21.4–21.6
2 Feb	21	Capacitors, ECG	21.7–21.8
5 Feb	22	Electric current	22.1–22.3
7 Feb	22	Ohm's law	22.4–22.6
9 Feb	**Exam 1**	**Chapters 16, 20-21**	
12 Feb	23	Intro to circuit diagrams	23.1
14 Feb	23	Kirchoff's Laws	23.2–23.3
16 Feb	23	Series, parallel and combinations	23.3–23.5
19 Feb	23	RC Circuits	23.6–23.8
21 Feb	24	Magnetic fields	24.1–24.3
23 Feb	24	Fields, forces and wires	24.4–24.6
26 Feb	24	Magnets	24.8
28 Feb	25	Induction	25.1–25.3
2 Mar	25	Faraday's law	25.3–25.4
5 Mar		**Spring Break**	
7 Mar		**Spring Break**	
9 Mar		**Spring Break**	

12 Mar	25	EM Waves	25.5–25.7
14 Mar	26	Alternating currents, transformers	26.1–26.3
16 Mar	**Exam 2**	**Chapters 22-25**	
19 Mar	26	Oscillation circuits	26.4–26.7
21 Mar	17	Wave optics	17.1–17.2
23 Mar	17	Gratings and thin films	17.3–17.4
26 Mar	17	Single-slit diffraction	17.5
28 Mar	18	Geometric optics	18.1–18.3
30 Mar	18	Image formation, thin lenses	18.4–18.5
2 Apr	18	Spherical mirrors	18.6–18.7
4 Apr	19	Cameras, human eyes	19.1–19.3
6 Apr	19	Microscopes	19.4
9 Apr	27	Special relativity	27.1–27.4
11 Apr	**Exam 3**	**Chapters 17-19, 26**	
13 Apr		**Good Friday**	
16 Apr	27	Consequences of spec. rel.	27.4–27.7
18 Apr	28	Photoelectric effect	28.1–28.3
20 Apr	28	Matter waves, quantization	28.4–28.8
23 Apr		REVIEW	
1 May	**Final Exam**	**8:30-11:30**	