PHYS 481: Physics Problem Solving

Instructor: Dr. Michael L. Larsen
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Office: RITA 317
Credits: 1
Term: Fall Semester
Class Meeting: Mondays, 6-6:50 PM, RITA 363

COURSE DESCRIPTION

Physicists are problem solvers. Often, a full solution to a system is unnecessary to grasp the central elements of a problem. This course utilizes the basic tools of symmetry, limiting cases, scaling, and dimensional analysis to engage in problem solving exercises where speed is more important than an exact closed-form solution. In particular, we will be focusing on approaches that are helpful for success on the Physics GRE examination.

PRE or CO-REQUISITE

PHYS 370 or ASTR 377

COURSE OBJECTIVES

1. Broadly review basic content from introductory and intermediate-level Physics courses.
2. Discuss the nature of the Physics Subject GRE test including the purpose of the exam, deadlines (including how they relate to graduate school application timetables), test-taking strategies, and the exam format (including topics covered).
3. Discuss and practice applying the basic tools of symmetry, limiting cases, scaling, and dimensional analysis to a variety of standard undergraduate-level Physics problems, including problems in areas where students have had little or no previous formal instruction.
4. Collaboratively work through problems on retired GRE examinations by combining previous Physics knowledge with skills developed elsewhere in the course
5. Solve so-called “Fermi Problems” (collaboratively and individually).

LEARNING OUTCOMES

1. Successful students will demonstrate substantial improvement in sample Physics subject GRE test performance.
2. Successful students will be able to professionally present solutions to both pre-prepared and extemporaneous “Fermi Problems”.
3. Successful students will be able to identify their own personal areas of weakness on GRE-type tests to help target their studying patterns for subject GRE and Major Field Test assessments.
4. Successful students will be able to discard incorrect proposed solutions to complex physics problems by using symmetry, limiting cases, scaling, and dimensional analysis.

GRADING

Grades will be based on the following components:

1. Attendance and Participation (15%)

   Attendance in this class is critical to the student experience. The skills to be developed in this class rely on practice which will include carefully designed dialogue between students and the instructor. The instructor uses counter-examples to demonstrate how the central tools used in this course (symmetry, limiting cases, scaling, and dimensional analysis) apply to each problem. Since each problem applies these ideas in slightly different ways, students must be present for these discussions to develop an understanding of the course content.

2. Completion and Self-Evaluation of 6 Sample GRE Exams (70% total)

   Each of the 6 Sample GRE exams is 100 questions, which the student has 2 hours and 50 minutes to answer. The completion of these tests will, thus, take a total of about 17 hours (outside of class). Students will be expected to also write a brief (1-2 paragraph) reflection on each sample testing experience.

3. Preparation and Presentation of Fermi Problem (15%)

   Each student will be tasked with preparing and presenting a professional solution to a so-called "Fermi Problem". The presentations will include the prepared Fermi Problem (70%) and a solution of an extemporaneously posed problem (30%). Presentations will be graded for clarity, accuracy, and appropriate use of skills developed in the class. The prepared presentation will be expected to be approximately 5-10 minutes in duration, and include pre-prepared audio-visual aids.

GRADING SCALE

The grading scale applied to this class will be:

A:	91-100	C+:	79-80	D-:	60-61
A-:	90-91	C:	71-79	F:	<60
B+:	89-90	C-:	70-71		
B:	81-89	D+:	69-70		
B-:	80-81	D:	61-69		

STUDENTS WITH DISABILITIES

The College will make reasonable accommodations for persons with documented disabilities. Students should apply for services at the Center for Disability Services/SNAP located on the first floor of the Lightsey Center, Suite 104. Students approved for accommodations are responsible for notifying me as soon as possible and for contacting me one week before accommodation is needed.

COLLEGE OF CHARLESTON HONOR CODE AND ACADEMIC INTEGRITY

Lying, cheating, attempted cheating, and plagiarism are violations of our Honor Code that, when identified, are investigated. Each incident will be examined to determine the degree of deception involved. Incidents where the instructor determines the student's actions are related more to a misunderstanding will handled by the instructor. A written intervention designed to help prevent the student from repeating the error will be given to the student. The intervention, submitted by form and signed both by the instructor and the student, will be forwarded to the Dean of Students and placed in the student's file.

Cases of suspected academic dishonesty will be reported directly by the instructor and/or others having knowledge of the incident to the Dean of Students. A student found responsible by the Honor Board for academic dishonesty will receive a XF in the course, indicating failure of the course due to academic dishonesty. This grade will appear on the student's transcript for two years after which the student may petition for the X to be expunged. The F is permanent. The student may also be placed on disciplinary probation, suspended (temporary removal) or expelled (permanent removal) from the College by the Honor Board.

Students should be aware that unauthorized collaboration--working together without permission--is a form of cheating. Unless the instructor specifies that students can work together on an assignment, quiz and/or test, no collaboration during the completion of the assignment is permitted. Other forms of cheating include possessing or using an unauthorized study aid (which could include accessing information via a cell phone or computer), copying from others' exams, fabricating data, and giving unauthorized assistance. Research conducted and/or papers written for other classes cannot be used in whole or in part for any assignment in this class without obtaining prior permission from the instructor.

Students can find the complete Honor Code and all related processes in the *Student Handbook* at http://studentaffairs.cofc.edu/honor-system/studenthandbook/index.php

OFFICE HOURS

Mondays, Wednesdays, and Fridays from 7-8 AM (in room RITA 387), Mondays from 5-6 PM and Tuesdays from 8-9 AM (both in my office). If you need help outside of ``official office hours", try to find me and most often I'll happily drop what I'm doing to help you. If I'm not where you expect me to be, check my office door. I will try to have some sort of sign indicating where I am.

Class Schedule (Tentative)

The registrar has this course listed as a 1 hour-per-week course that meets for the entire semester. The challenge with this meeting schedule is that many of you will have already taken the subject GRE exam about 2/3 of the way through the semester. In order to help you prepare for this exam on a timetable that is useful to those taking the subject GRE test this fall, I propose that we meet nominally 1.5-2 hours per week for the first 2/3 of the semester or so, and then give ourselves the last few weeks of the semester off. The reasons for this adjusted meeting schedule are:

1. This allows us to complete our test preparation before the actual GRE test dates this fall.
2. Your load for this class will be frontloaded at the beginning of the semester, so you can focus your efforts on your other classes at the end of the semester.

3. We avoid our currently scheduled final exam time slot (which – if we don't adjust our schedule – is likely to be the very last time slot.). Instead, we will complete our final presentations during the regular semester around ¾ of the way through the term.

The below schedule has been constructed *assuming* we will be able to use the revised 1.5 hour/week for the first 2/3 of the semester schedule proposed above. If there are objections, the tentative schedule outlined below will be revised accordingly.

Week 1 (August 27): Discuss the Structure and Purpose of the General GRE Exam, Subject GRE Exam, and discuss timelines associated with applying and taking the subject GRE Exam and how they relate to the grad school application process. Discuss general test-taking strategies. Discuss topics typically covered on subject GRE exam. General Q&A about the general and subject GRE exams and graduate school. Review of introductory Physics

Week 2 (September 3): Work through problems on the first sample GRE test that students have historically struggled with. Show examples of questions that can be productively addressed by appeals to symmetry, limiting cases, scaling, and/or dimensional analysis. First Sample GRE Test DUE!

Week 3 (September 10): First Sample GRE Test Returned! Work through problems on the first sample GRE test that students struggled with. [First real Physics GRE test date for 2018 is offered the weekend after this class.] Second Sample GRE Test DUE!

Week 4 (September 17): Second Sample GRE Test Returned! Work through problems on the first and second sample GRE tests.

Week 5 (September 24): Work through problems on the second sample GRE test. Third Sample GRE Test DUE!

Week 6 (October 1): Third Sample GRE Test Returned! Work through problems on the third sample GRE test.

Week 7 (October 8): Work through problems on the third sample GRE test. Fourth Sample GRE Test DUE!

Week 8 (October 15): Fourth Sample GRE Test Returned! Work through problems on the fourth sample GRE test. Fifth Sample GRE Test DUE!

Week 9 (October 22): Fifth Sample GRE Test Returned! Work through problems on the fifth sample GRE test. Give last minute help/advice for GRE. Sixth (Final) Sample GRE Test DUE! [Second real Physics GRE test date for 2018 is offered the weekend after this class.]

Week 10 (October 29): Sixth Sample GRE Test Returned! Brief intro to Fermi Problems. Fermi Problems assigned / presentation dates assigned. (Likely a shorter than usual class day.)

Week 11 (November 5): Fall Break

Week 12 (November 12): Fermi problem presentations
Week 13 (November 19): Fermi problem presentations (if needed; otherwise no class)

Week 14 (November 26): Class likely will not meet
Week 15 (December 3): Class likely will not meet
Final Exam Time Slot: Class likely will not meet.