UNIVERSITY OF CALIFORNIA, MERCED
Physics 009 – Electricity and Magnetism
Fall 2012
COB 105
Tuesdays, Thursdays: 10:30-11:45 am

Instructor: Prof. Sai Ghosh (SE 352, sghosh@ucmerced.edu)

Office Hours: Mondays, 3:00-5:00 pm, SE 352

TAs: Niko Gorjup (ngorjup@ucmerced.edu)
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Alessandro Castelli (acastelli@ucmerced.edu)
(TAs will also maintain office hours)

MP ID: UCMPHYS9FALL2012GHOSH

Textbook requirements:

- *Physics for Scientists and Engineers: A Strategic Approach, 2nd ed.* by Randall D. Knight
- MasteringPhysics online homework system.
- Student Workbook for *Physics for Scientists and Engineers* (optional, at your discretion)

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I. Course Description: The study of Electricity and Magnetism is concerned with a set of physical laws describing interactions of material objects under the action of a system of forces. This course will be an introduction to the basic principles, including electrical and magnetic forces, associated fields and conservation of charge and energy.

II. Course Goals and Outcomes:

a. ***Course Goals:*** This course is a study of electricity and magnetism and the language of the subject will be developed analytically and quantitatively, but we will use qualitative description for a clear understanding of the physical phenomena. We will place particular emphasis on the fundamental laws and their applications under different physical situations. In addition, a small part of this course will be geared towards introducing you to some relevant and current research topics in physics.

b. ***Learning Outcomes:*** This course is more analytical than qualitative. At the completion of this class, you will be expected to be able to do the following: (a) develop a strong foundation in mathematical techniques, (b) apply these techniques to solve problems, (c) interpret and explain simple everyday observations based on electrical and magnetic interactions, and (d) have some understanding about what are interesting areas of research in the current setting.

c. **Student Learning Objectives (SLO's):** This course aims to give you a deep understanding of the relevant physical principles by introducing you to the concept of forces and fields. At the end of the course you should be able to:

1. Have a firm grasp of fundamental principles of electricity and magnetism. You should be able to simplify and model everyday systems in a physically reasonable and tractable fashion.
2. Utilize the formal and mathematical techniques learnt in the course to predict various properties of a system at hand.
3. Verbally, and in writing, communicate what your predictions mean in a real laboratory or natural setting.
4. Have a basic idea of what encompasses cutting edge research in physics both in terms of topics and methodology.

Summary of how various components of the course address different SLO's:
Lectures: # 1, 2, 3
Homework: # 1,2,3,4
Exams: # 1,2,3,4
Labs: # 1, 3, 4
Literature review: #3, 4

d. **Relation to programmatic learning objectives (PLOs):** Graduates from the Physics B.S. program will have demonstrated the following learning outcomes.

1. *Physical Principles.* Students will be able to apply basic physical principles—including classical mechanics, electricity and magnetism, quantum mechanics, and statistical mechanics—to explain, analyze, and predict a variety of natural phenomena.
2. *Mathematical Expertise.* Students will be able to apply advanced mathematical techniques (e.g., calculus, linear algebra, probability, and statistics) in their explanations, analyses, and predictions of physical phenomena.
3. *Experimental Techniques.* Students will be able to take physical measurements in an experimental laboratory setting and analyze these results to draw conclusions about the physical system under investigation, including whether their data supports or refutes a given physical model.
4. *Communication and Teamwork Skills.* Students will be able to clearly explain their mathematical and physical reasoning, both orally and in writing, and will be able to communicate and work effectively in groups on a common project.
5. *Research Proficiency.* Students will be able to formulate personal research questions that expand their knowledge of physics. Students will be able to apply sound scientific research methods to address these questions, either by researching the current literature or developing independent results.

Below I tabulate how the PLOs are addressed by this course:

Course component	*PLOs*
Lectures	1,2,4
Homework	1,2,4
Exam	1, 2, 4
Lab	2, 3, 4, 5
Literature Review	4, 5

III. Format and Procedures: This course consists of lectures and discussions every week, and labs during particular weeks throughout the semester. The lecture will be conducted by the me during which we will go over course material as outlined in Section VIII. You are expected to attend lectures and take notes. I strongly suggest that you make every effort to attend lectures so you remain aware of the material being covered as well as initiate discussions with me in case you have any doubts. You will also have TAs who will lead discussion sessions every week. The TAs will not cover any new material during discussions, but will explain what is already covered in class. They will also assist you with your homework, but only as far as getting you started and explaining concepts you need help with.

IV. Course Requirements:

a. Class attendance and participation policy: Attending lectures is at your discretion. It will be your responsibility to make sure you know what has been covered in class and understand the concepts as best as you can, if you choose not to attend lectures. As your instructor, I strongly recommend you attend lectures.

b. Course readings: I suggest that after each week's lecture, you take some time to go over your lecture notes and the relevant portion in the text (as outlined in the weekly schedule below). We will cover a lot of material in class every time we meet and unless you understand the previous week's lectures well, you will get lost very quickly.

c. HW assignments: Homework will be assigned every week. All homework assignments together will account for 15% of your course grade. Each week HW will include online submission using Mastering Physics. It will be impossible for you to get a high course grade if you do not submit a majority of your assignments. Further, homework problems will be non-trivial and time consuming – they are meant to take up about 6-8 hours of your time per week. Do your HW assignments carefully and devote the time they need. This is the only way to truly understand the course material and to prepare for the exams.

d. Examinations: You will have a midterm around the 9th week of the semester and a final exam at the end of the class. The midterm exam will be in class. Please check the Registrar's schedule for final exam date and time. These are inflexible. If you miss either the midterm or the final, it is not logistically possible to provide you with a make up exam. If you had a medical reason to miss the exams please bring a doctor's note and I will drop the

exam for calculation of your course grade. ***Without a doctor's note, you will get a zero for missed exams and that will be incorporated in your course grade.***

e. Labs: Please take your time to understand what you are doing, both from the instrumentation aspect and the conceptual perspective. The grade you will be assigned in lab will depend on both the quality of your participation and your answers on the questionnaire that accompanies each lab. Tentative Lab schedule is as follows:

Topic	***Week***	***Prelab***
Potential and Field 1	5	
Potential and Field 2	6	
DC circuits	8	
e/m	10	yes
Oscilloscopes	12	
Diffraction	15	yes

f. Literature Review: Classical Mechanics is one of the very basic subjects that constitute Physics, but it is far removed, in many ways, from current research areas and applications. To make sure that you get a taste of how physics is done in research labs, how results are reported, what the important research areas are and how to be trained in research, I have included a literature review in your course grade. Please read the carefully:

i. You can pick any one topic from the list below. On the topic of your choice write a 500 word literature review of the current status of research in that field. ***Your review will introduce the topic, summarize current important results, report possible important applications and end with a brief indication of where the field is headed in the near future.***

ii. This has to be original work – you can of course refer to any resources in literature or websites as you see fit – but no copying from any other sources. Please keep this in mind, the UC has very strict rules about plagiarism. It guarantees severe action against the student. Read, understand and write in your own words.

iii. Your write up must be referenced (it should have references mentioned that you have used as your source material). If you are not sure how to do this, please look up a scientific article in any journal. ***No reference must be more than 3 years old.*** I want to make sure you are reporting current research.

iv. You may submit this to me ANYTIME during the semester. But the latest I will accept this is November 30th. Please email me your writeup as a pdf file to sghosh@ucmerced.edu. No other form of submission will be accepted.

v. The topics include:
   - Higgs Boson
   - Superconductivity
   - Polymer solar cells
   - Topological insulators
   - Casimir effect

V. Grading Procedures:

a. Homework: 15%
b. Midterm: 25%
c. Final examination: 30%
d. Lab: 20%
e. Literature Review: 10%

VI. Academic Integrity:

a. Each student in this course is expected to abide by the University of California, Merced's Academic Honesty Policy. Any work submitted by a student in this course for academic credit will be the student's own work.

b. You are encouraged to study together and to discuss information and concepts covered in lecture and the sections with other students. You can give "consulting" help to or receive "consulting" help from such students. However, this permissible cooperation should never involve one student having possession of a copy of all or part of work done by someone else, in the form of an e mail, an e mail attachment file, a diskette, or a hard copy. Should copying occur, both the student who copied work from another student and the student who gave material to be copied will both automatically receive a zero for the assignment. Penalty for violation of this Policy can also be extended to include failure of the course and University disciplinary action.

c. During examinations, you must do your own work. Talking or discussion is not permitted during the examinations, nor may you compare papers, copy from others, or collaborate in any way. Any collaborative behavior during the examinations will result in failure of the exam, and may lead to failure of the course and University disciplinary action.

VII. Accommodations for Students with Disabilities: The University of California Merced is committed to ensuring equal academic opportunities and inclusion for students with disabilities based on the principles of independent living, accessible universal design and diversity. I am available to discuss appropriate academic accommodations that may be required for student with disabilities. Requests for academic accommodations are to be made during the first three weeks of the semester, except for unusual circumstances. Students are encouraged to register with Disability Services Center to verify their eligibility for appropriate accommodations.

VIII. Tentative Weekly Lecture Schedule (Subject to change):

Wk	Dates	Lecture Topic	Knight	Due
1	8/23	Electric charges and force	26	
2	8/28, 8/30	Electric field	27	**HW1: 8/31**
3	9/4, 9/6	Gauss Law	28	**HW2: 9/7**
4	9/13	Electric potential	29	**HW3: 9/14**
5	9/18, 9/20	Potential and field	30	**HW4: 9/21**
6	9/25, 9/27	DC circuits	31, 32	**HW5: 9/28**
7	10/2, 10/4	Ohm's law, Kirchoff's law	31, 32	**HW6: 10/5**
8	10/9, 10/11	Magnetic field	33	**HW7: 10/12**
9	10/16, 10/18	Magnetic field, **Midterm**	33	**HW8: 10/19**
10	10/23, 10/25	Electromagnetism	34	**HW9: 10/26**
11	10/30, 11/1	AC circuits	36	**HW10: 11/2**
12	11/6, 11/8	Electromagnetic waves	35	**HW11: 11/9**
13	11/13, 11/15	Travelling waves	20, 21	**HW12: 11/16**
14	11/20, 11/27	Wave optics	22	**HW13: 11/23**
15	11/29, 12/4	Ray optics	23, 24	**Lit. Rev. 11/30** *(email only)* **HW14: 11/30**
16	12/6	Review		
17	**12/8**	***Final***		