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Physics 142 Electricity and Magnetism Fall 2015

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Office Hours: MWF 11AM, MW Noon.

Text: *Fundamentals of Physics, 10th edition, extended, by Halliday, Resnick and Walker.*

Prerequisite: Calculus 2 or equivalent.

Materials: You will need a calculator that can do algebraic and trig functions, as well as statistical functions. A TI calculator would be preferred.

Content: This course explores the physics principles of thermodynamics, electricity and magnetism. We start with taking the elements you studied in Physics 141 (or the equivalent) and using them to understand the behavior of gases. Atoms and molecules are moving fast and they bump into the walls of this room. In so doing, they create pressure and temperature. Using principles of mechanics, we can derive a connection between the movement of molecules and the temperature of the environment. And an increase in temperature causes molecules to move faster and possibly expand their domain (expansion). Systems in contact with one another can exchange this energy (by conduction, convection, or radiation) and engines can be designed to systematically take energy from the environment (stored in chemical bonds) and release it to create kinetic energy which is then used to do work. The first and second laws of thermodynamics govern the exchange process and the efficiency with which engines perform.

Next we look at the physics of electric charge and the principles that govern such things as holding atoms together (Coulomb's Law) and the systematic movement of charges through materials (Ohm's Law). We will use the force principle and free-body diagrams to look at static arrangements of charges and movement of charges with constant acceleration. Systems of charges with special symmetry create unique electric effects (Gauss's Law) that can be exploited to create special electronic components. We'll use the energy principle to look at the conduction of charges through material. In lab, we'll explore electricity using various instruments such as power supplies, signal generators, voltmeters, ammeters, and oscilloscopes.

The latter section of the course is devoted to principles of magnetism. Moving charges create magnetic fields (Biot-Savart Law, Ampere's Law), so we can make a magnet out of a systematic conduction of electricity. Other moving charges that feel the presence of magnetism experience a force, so we have forces between conducting systems. With clever design, we can use this magnetic interaction to cause rotation of an electric circuit and make a motor. A changing magnetic field can induce a voltage in a circuit (Faraday's Law) and so cause the generation of electricity. This creates an interesting interplay between the electricity and magnetism components of the course.

Week	Chapters	Lecture Content	Lab
8-24	18,19	Ideal gas law, gas kinetics, expansion/contraction, Maxwell-Boltzmann distribution, first law, specific heat, latent heat	Ideal Gas Law, Assessment Pre-Test, Lab Safety Introduction
8-31	18,19	Calorimetry, heat exchange: conduction, convection, radiation, work done and energy exchanged by gases, PV diagrams	Thermal Expansion
9-7	19,20	Constant P, constant V, constant T, and adiabatic processes, net work by heat engine, efficiency, second law	Specific Heat
9-14	20,21	Entropy, Carnot engine, refrigerators, coefficient of performance, electric charge, Coulomb's Law, Exam 9-18	Lab Assessments: Specific Heat of an Unknown, Standard Error of Expansion Coefficient, Review
9-21	22,23	Electric field, static charges, E-field from systems of point charges, projectile motion of charges, Gauss for spherical symmetry	Heat of Fusion of Ice
9-28	22,23	Electric field from continuous systems of charge (non-Gauss integration), Gauss for cylindrical symmetry, induced charge	Equipotential Surfaces
10-5	23,26,27	Gauss for planar systems, electrical conduction, electric potential, resistivity, Ohm's Law, resistor, ammeter, voltmeter, series circuit	Resistivity
10-12	24,25,26	Electric potential, energy principle applied to electricity, power dissipated, capacitor, dielectric, energy stored, Exam 10-16	Lab Assessments: Voltage Contours and Field Lines, Circuit-Wiring and Resistance, Review
10-19	25,26,27	Series and parallel combinations of resistors and capacitors, currents thru and charges stored in R and C circuits	Series and Parallel Circuits
10-26	25,27	Multi-loop circuits with multiple voltage sources, series RC and time constant, branched circuits with R's and C's	RC Circuits
11-2	28	Magnetic field, magnetic force on single charges, right-hand rule, centripetal motion of charges, velocity selector, Exam 11-6	Lab Assessments: Resistor Network, Calibration of Oscilloscope and Half-Life, Review
11-9	28,29	Magnetic force on conductor, torque on current loop, Hall Effect, B-field from moving charges, Biot-Savart Law	Charge-to-Mass Ratio of Electron
11-16	29,30	B-field from systems of infinite wires, Ampere's Law, B-field for systems with cylindrical symmetry, electromagnetic induction	LR Circuits
11-23	30	Faraday's Law, voltage and current induced in Cartesian and polar systems, Lenz's Law, induction in circuits with changing geometry	No lab Tuesday, Thanksgiving Thursday
11-30	30,31	B-field of an inductor, current flow in LR circuit, time constant and half-life, L, R, and C with AC source, impedance, Exam 12-4	Lab Assessments: Standard Error of e/m, Oscilloscope and LR Circuit, Review
12-7	31,32	Transformer, magnetic materials, Maxwell's Equations, ferromagnetism, para-magnetism, diamagnetism, review	LRC Circuits
12-14	-----	Final Exam either 12-16 at 8 AM or 12-17 at 8 AM	Finals Week (no lab)

Lecture

Lectures will have an interactive workshop format, driven by PowerPoint instructional resources. We will work together in learning teams, each team of about three people. I will begin each lecture with an overview of the agenda and highlight points of emphasis and facilitate additional instruction and clarification as the team experience develops. At all times, we can have discussions about homework problems and go back to previous lectures as the need arises. The goal of each lecture is to not only grasp the principles presented but also to make progress in their application, and to get a strong start on homework challenges, an area that is historically weak in Phy 142.

The lecture PowerPoints will give you a complete development of the material, from the presentation of the foundation principles to example calculations, sketches, strategies as well as questions and problems for the team to tackle. Intermittently, when the team has achieved certain goals, you will be prompted to touch base with me regarding your progress.

There is a participation grade for lectures, on a scale of 0-2. With this type of format, it can be a challenge to stay on task. So while the goal is to enjoy the process and work at a pace that is comfortable for you, try to encourage one another along the way. The more we can accomplish in here, the less you will need to do when you go it alone outside of class. I hope not to have to assess 0's and 1's, but here is a guideline. A grade of '2' is for satisfactory progress and a strong team focus. A grade of '1' will be assessed if a chronic lack of focus seems to be hindering the pace and quality of the learning process. A grade of '0' will be assessed for evil things like falling asleep, facebooking, texting, web-surfing … you get the idea. The total of your participation grades will count for 5% of your overall course grade.

Each lecture will be posted on the Cobra Learning system at least 24 hours in advance of the lecture. Not a bad idea to peruse it before coming to class. The computer tablets that we use have note-taking capability, and you are strongly encouraged to use this feature. But some find they prefer taking notes on paper. I will provide a hardcopy of the PowerPoints only if a computer is not available to you. With budget crunches, hardcopies are limited, so you might consider printing out a copy for yourself before class if you so desire.

In addition to the PowerPoint uploaded on Cobra Learning, I will also upload a pdf version as well. I invite you and encourage you to bring your own laptop if you wish with the pdf version downloaded. As a matter of fact, the visual quality of the pdf's are almost as sharp as the PowerPoints. And because we have a shortage of tablet PC's, it would be great if a few folks brought their own PC's. However, the same guidelines apply on the 0's, 1's, and 2's.☺

It would be good to bring a flash drive to every class. If you have PowerPoint loaded on your computer, save your work as a pptx, otherwise save as an Adobe pdf to view later.

Quizzes, Exams, etc.

Homework assignments and due dates are listed on the HW document. Homework will not be handed in for a grade, but you are encouraged to keep a notebook of completed homework problems. Homework assignments will also be posted on Cobra Learning.

Try to set a firm goal for yourself to come to each lecture having prepared the assignment that is due. Seek out help from Peer Tutoring or come to talk to me during office and lab hours, but try your very best to stay current with homework. I welcome HW questions and am willing to give hints and strategies for solving them, but I will stop short of working out the problems for you in detail. There really is no substitute for spending the time yourself, even though it can get frustrating at times. There are some very challenging topics in 142 and even the very best students struggle at times.

During the last 10 minutes of each lecture session, there will be a quiz that will be due at the end of the session. You can work together in your team on quizzes. Quizzes will typically be similar to or at least related to the homework assignment that is due at that session. Quizzes will also have a competitive aspect to them as well. The first team to submit a correct quiz will score a 3-pointer. The next correct quiz gets a 2, and all remaining correct submissions score a 1. These points accumulate for the groups and in subsequent sessions, the group can wager any or all of their points. Based upon quiz performance, team members will be eligible for extra credit on exams.

Correct quizzes accumulate extra credit for you in the overall course. Every correct quiz that you submit (it's all or nothing … either correct or it's wrong) gives you an increase of 0.1% of your final course grade. Doesn't seem like much, but we will have something like 30-35 quizzes.

During the week of an exam, I will distribute a practice exam. The purpose of this is to help you sharpen up your skills, and get comfortable with the test-taking routine. On each exam, roughly 50% of it will be built around situations that are similar to homework problems, though they will not be exactly the same. I will make some revisions to problems you have done and may ask about other aspects of these problems. This component of the exam will be multiple-choice with no partial credit, so it is imperative as we approach an exam to have firm mastery of the body of homework related to the exam.

One goal of the novel lecture approach is to avoid the traditional exam crunch that tends to create so much stress and confusion, particularly toward the end of 142.

There will be 4 one-hour tests during the semester: 9/18, 10/16, 11/6, and 12/4.

There is a final exam for the course: Wednesday, December 16th from 8AM to 10AM, or Thursday, December 17th from 8AM to 10AM.

Laboratory

You have registered for a lab section that meets for a 3-hour block of time each Tuesday or Thursday.

Each week there will be a handout distributed at the start of the lab session that will outline your experiment/activities.

We will keep lab sections at no more than 4 persons each (and 3 or fewer if possible).

It is important that you arrive on time to begin your lab session. A 5% deduction will be assessed in the grade for the lab if you arrive more than 10 minutes late. It may not be possible for you to start a lab if you arrive more than 20 minutes late.

Lab reports must be handed in before you leave the lab.

Data that you include must be legitimate data collected during the lab session. Lab reports from previous semesters will not be allowed into the lab rooms.

Lab reports which are copied in full or in part will be considered cheating and may result in a failing grade for the course.

Grades

The grades are compounded in the following way:

4 one-hour tests	**60%**
2-hour final	**20%**
Labs	**15%**
Participation	**5%**

Letter grades will be assigned as follows: A – 90.0%, B – 80.0%, C – 70.0%, D – 60.0%.

You must earn 60% on the laboratory part of the course to receive a passing grade for the course.

If you have been absent for no more than 5 of the lecture sessions (you will be counted as absent if you miss more than 10 minutes of a given lecture session), then you may drop your lowest one-hour test. Also, you may drop your lowest lab of the semester. The percentage allotted to the dropped items will be added to the percentage allotted to the final exam.

There will be no make-up quizzes, exams, or labs under any circumstances.

General Education

This course fulfills the following General Education objectives listed in the Parkland catalog. Students will:

- **demonstrate their ability to solve problems, by collecting and evaluating facts and using methods of scientific inquiry;**
- **demonstrate their ability to compute and to think and express themselves effectively in quantitative terms.**

Disability

If you believe you have a disability for which you need an academic accommodation (e.g., an alternative testing environment, use of assistive technology, or other classroom assistance) please contact Cathy Robinson (U260, 353-2082), Director of Disability Services, crobinson@parkland.edu. Also talk to me as soon as possible.

Center for Academic Success

If you find yourself needing assistance of any kind to complete assignments, stay on top of readings, study for tests, or just to stay in school, please contact one of the following staff at the Center for Academic Success:

Anita Taylor
Room: D120
Phone: 353-2005

Sue Schreiber
Room: D120
Phone: 351-2441

You may also email the CAS at CenterForAcademicSuccess@parkland.edu.

Academic Honesty

I have found there to be an increase in the frequency of cheating incidents in recent years. The Student Policies/Procedures Manual (www.parkland.edu/studentpolicy/honesty) defines cheating, fabrication, and plagiarism. Consequences can carry the penalty of a failing grade for the course and possibly suspension from the course.

Be mindful of a few ground rules regarding test-taking (quizzes will be collaborative efforts and do not apply here). Tests are closed-book and the following things would be considered cheating:

- exchange of materials of any kind (calculators, pencils, pens, information, anything)
- any talking
- looking at someone else's work

Core Values

I believe strongly in the Core Values espoused by Parkland College: Honesty and Integrity, Fairness and Just Treatment, Responsibility, Multiculturalism, Education, and Public Trust. Essentially, these values set guidelines for how we should treat one another. Failure to be respectful of one another or to maintain ethical behavior will not be tolerated.

Drops/Withdrawals

On the ten-day roster, I am required to assess your attendance. If you have not attended regularly to that point, you will be dropped with no refund of tuition or fees. After the ten-day roster, you should not plan on an instructor withdrawal if you want to withdraw from the course. You are ultimately responsible for your own withdrawal by the withdrawal date. Non-attendance after the ten-day roster will result in an F if you don't withdraw yourself.

Note: Please refer to the Syllabus Addendum document (posted on Cobra Learning) for additional College policies.

Due Dates for Homework (from Halliday, 9th or 10th)

8/28	Fri	Ch 19: 3, 9
8/31	Mon	Ch 19: 21, 23
9/2	Wed	Ch 18: 17, 21
9/4	Fri	Ch 18: 31, 39
9/7	Mon	----------
9/9	Wed	Ch 18: 41, 54
9/11	Fri	Ch 18: 42 (ans. 8.71 g), 55
9/14	Mon	Ch 18: 61 , Ch 20: 33
9/16	Wed	Ch 20: 27, 29
9/18	Fri	Ch 20: 35
9/21	Mon	Ch 21: 49
9/23	Wed	Ch 21: 3, 11
9/25	Fri	Ch 21: 39, 42 (ans. 2.38×10^{-8} C)
9/28	Mon	Ch 22: 7, 19
9/30	Wed	Ch 22: 47, 84 (ans. (b) 2.72 cm)
10/2	Fri	Ch 22: 32 (ans. (a) 12.4 N/C)
10/5	Mon	Ch 23: 32 (ans.(a) 1.91 N/C, (b) 3.62 N/C), 51
10/7	Wed	Ch 23: 29, 49
10/9	Fri	Ch 23: 33, 43
10/12	Mon	Ch 22: 33
10/14	Wed	Ch 24: 14 (ans. (a) -4500V, (b) -4500V), 17
10/16	Fri	Ch 24: 41, 51
10/19	Mon	Ch 24: 45, 49
10/21	Wed	Ch 26: 15, 25
10/23	Fri	Ch 25: 3, 43

10/26	Mon	Ch 25: 50 (ans. 4.55×10^{-11} F), Ch 27: 22 (ans. (a) 2.50Ω, (b) 3.13Ω)
10/28	Wed	Ch 25: 15, Ch 27: 44 (ans. (a) 119Ω, (b) 0.0505A, (c) 0.0189A, (d) 0.0189A, (e) 0.0126A)
10/30	Fri	Ch 27: 23, 45
11/2	Mon	Ch 27: 63, 65
11/4	Wed	Ch 27: 57, 61
11/6	Fri	Ch 27: 91
11/9	Mon	Ch 28: 3
11/11	Wed	Ch 28: 1, 5
11/13	Fri	Ch 28: 11, 23
11/16	Mon	Ch 28: 27, 41
11/18	Wed	Ch 28: 49, Ch 29: 1
11/20	Fri	Ch 29: 11, 13
11/23	Mon	Ch 29: 41, 48 (ans. (a) .003A, (b) into page)
11/25	Wed	Ch 29: 21, 47
11/27	Fri	----------
11/30	Mon	Ch 30: 27
12/2	Wed	Ch 30: 26 ((a) 5.98×10^{-7}V, (b) CCW), 28 ((b) 1.03×10^{-5}A), CW)
12/4	Fri	Ch 30: 33 (ans. $v=mgR/(L^2B^2)$), 34
12/7	Mon	Ch 30: 11
12/9	Wed	Ch 31: 35, 41
12/11	Fri	Ch 31: 45