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# Physics 212 Electromagnetism

<http://www.physics.pdx.edu/~larosaa/Phy-222/Physics-222.html>

Summer-2008  
Room CH 250  
MTWRF 11:45-14:05 PM  
<http://www.physics.pdx.edu/~larosaa/>

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Office Hours: Th: 10:40-11:40

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**Text\*:** Fundamentals of Physics: 6th Edition; by Halliday, Resnick and Walker

**Grading:** 1<sup>st</sup> Exam 50% July 28<sup>th</sup>, 2008  
Final exam 50% August 7<sup>th</sup>, 2008

**Lecture Notes** Available online at this course's website

**Students who typically do well in this course:**

They have active participation in class.  
Solve a minimum of 15 questions or problems from each chapter.  
Choose your practice problem from either this syllabus or the ones suggested during the lectures.

**Syllabus updates** Check updates at this course's website  
Syllabus may be updated as the course progresses.

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## INTRODUCTION

This course starts with the introduction of concepts related to just electricity: charge, electric field, electric potential energy, conservation of electric energy, etc. You can notice that some of these terms sound already very familiar to what you have learned in PH-211. Indeed, in PH-212 we will use those same concepts, such as potential energy and conservation of energy, that were introduced in PH-211 when studying the gravitational force, the spring force, etc. You may remember that for each (conservative) force we associate a corresponding potential energy. The nice surprise we have for you is that the only difference in PH-212 is that we will apply all those concepts to the particular case of the ELECTRICAL FORCE. So a great deal of your time will be devoted mainly to familiarize with the new terminology. The physics background is the same that you have already learned in PH-211.

In Part-1 of this summer session we will apply the concepts of electricity to situations where the charges involved are at stationary positions; this is the reason for the name "Electrostatic". In Part-2, we will apply them to cases where the charges are in motion.

Charges in motion produce magnetism. This is very interesting! Just placing a charge in motion gives rise to magnetism. This means that electricity and magnetism are manifestation of the same physical property: the **electrical charge**.

A very curious student will argue: wait a second, whether a charge is in motion or not is relative. A guy in a particular system of reference may see a charge at rest (he will see then only electrostatic phenomena); for another guy in motion with respect to the first one will see the charge in motion (he will see electricity and magnetism phenomena). How could it be one guy see different phenomena than the other, just because they are moving relative to each other? Indeed, that is what happens; the observers in different system of reference will see different

electromagnetic phenomena. This reveals another interesting phenomenon in physics: Electricity and magnetism are relativistic concepts; their values depend on what system of reference you are using to measure them.

Since electricity and magnetism are so intrinsically related, one depending on the other, we call this course electromagnetism

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## **PART-1: ELECTROSTATICS** **(Charges located at stationary positions)**

<u>Date</u>	<u>Covered Chapter</u>	<u>Highlight topics</u>
07/17	Ch-22	<b>Electromagnetism</b> (electricity and magnetism). <b>Electric charge</b> , charge conservation, conductors and insulators. Interaction between charges: <b>Coulomb's law</b> <i>Practice problems Ch-22</i> (Q1, Q2, Q3, Q4, Q5, Q6, 2E, 4E 8P, 15P, 16P, 18E, 23E, 25P)
07/18	Ch-22, Ch-23	<b>Electric Field</b> (vector) Electric field due to: a punctual charge, a line of charge, a charged disk. <i>Practice problems Ch-23</i> (Q5, Q7, Q8, 7,8P, 10P, 11P, 13P, 18E, 20P, 23P, 24P, 41P, 43P)
07/21	Ch-24	<b>Gauss' law</b> . Calculation of electric fields established by charges distributed symmetrically. The derivation of Gauss' law involves a somewhat abstract mathematical concept (be prepared), but its use simplifies tremendously the calculation of electric fields. <i>Practice problems Ch-24</i> ( Q1, Q3, Q6, Q8, Q10, 2E, 3E, 7P, 9P, 12E, 17E,
07/22	Ch-24	<b>Gauss' law</b> . <i>Practice problems Ch-24</i> ( 19P, 22P,26E, 27E, 29P, 34E, 44P)
07/23	Ch-25	<b>Electric Potential Energy</b> . Work done by electric forces. Electric force is a conservative force, therefore a potential energy function can be defined. <i>Practice problems Ch-25</i> (Q1, Q2, Q4, Q7, Q8, 4E, 13E, 24E)
07/24	Ch-25	Calculating the <b>electric field (vector)</b> from the <b>electric potential (scalar)</b> <i>Practice problems Ch-25</i> (26E, 28P, 36E, 37E, 40P)
07/25	Ch-26	<b>Capacitance</b> . Charge storage, electrical potential energy storage <i>Practice problems Ch-26</i> (Q1, Q3, Q4, Q9, 5E, 10E, 18P, 23E, 27P) <b>Dielectrics</b> <i>Practice problems Ch-26</i> (34E, 36E, 40P)
07/28	<b>Exam 1 - Chapters 22-26</b>	

## **SECTION 2: CHARGES ARE IN MOTION and MAGNETISM**

<b><u>Date</u></b>	<b><u>Covered Chapter</u></b>	<b><u>Highlight topics</u></b>
07/29	Ch-27	<b>Current</b> , Resistance. <b>Ohms' law</b> <i>Practice problems Ch-27</i> (Q2, 12E, 16E, 20E, 34E)
	Ch-27, Ch-28	<b>Circuits.</b> Kirchoff's law <i>Practice problems Ch-28</i> (Q4, Q6, 4E, 5E, 12P, 18E, 21E, 26P, 28P, 33P, 36E, 37P, 44E, 46E)
07/30	Ch-29	<b>Magnetic Field</b> <i>Practice problems Ch-29</i> (Q1, Q4, Q9, 3E, 14P, 21E, 28P, 35E, 39E, 43P, 47P, 54P)
07/31	Ch-29, Ch-30	<b>Biot-Savart law:</b> Calculation of magnetic fields due to arbitrary distribution of currents. Force between two parallel currents. <b>Ampere's Law:</b> calculation of the magnetic field produced by a symmetric distribution of currents. <i>Practice problems Ch-30</i> (Q1, Q2, Q3, Q5, 1E, 6E, 9P, 10P, 11P)
08/01	Ch-30, Ch-31	<b>Faraday's Law of Induction</b> (this is a very important chapter). <b>Lenz's law:</b> a practical way to determine the direction of induced currents. <b>Concept of inductance.</b> Energy density contained in a magnetic field. <i>Practice problems Ch-30</i> (18P, 29P, 56P, 38P) <i>Ch-31</i> (Q1, Q3, Q5, 4E, 7P, 9P, 15P, 24P)
08/04	Ch-31	<b>Self-induction, energy stored in a magnetic field</b> <i>Practice problems Ch-31</i> (21P, 28P, 30P, 31P, 40e, 42P, 56E, 71P, 75P)
	Ch-31, Ch-32	<b>Magnetism and Matter.</b> Diamagnetism, Paramagnetism, Ferromagnetism <i>Practice problems Ch-32</i> (Q1, Q2, Q3, Q7, 12E)
08/05	Ch-32	<b>Concept of displacement current, Electromagnetic waves</b> <i>Practice problems Ch-32</i> (14E, 18E, 20E, 34P)
08/06	Ch-32, Ch-33	<b>Alternating current</b> <i>Practice problems Ch-33</i> (Q1, Q3, Q5, 4E)
	Ch-33	<b>Capacitive impedance, inductive impedance. Resonance</b> <i>Practice problems Ch-33</i> (10E, 13P, 23P)
08/07	<b>Final Exam</b>	<b>11:45-14:05</b>

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### \* Other References

1. Paul A. Tipler, "Physics" Volumes 1 and II, Fourth Edition. These two books will be available in the Library Reserved Room. This reference is very straightforward to explain electricity and magnetism concepts.

- 2. R. Feynman, R. Leighton, M. Sands; “The Feynman Lectures On Physics”; Vol-I and II; Addison-Wesley; QC21.2.F49 1989. This is an excellent reference that provides a deeper an clear explanation of physics concepts.**
  - 3. Ronald Lane Reese, University Physics, Brooks/Cole Publishing Company, 2000. Excellent book. This reference will be also available in the Library Reserved Room.**
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