ELECTRICITY AND MAGNETISM II

SYLLABUS *Physics 212*

Fall 2023

This is the "*electrostatics"* part of the two-part E&M sequence. The second part is concerned with "*electrodynamics",* the interaction between electric and magnetic fields and electromagnetic waves. This first part of the sequence is primarily concerned with static charges and steady-state currents, either in vacuum or in matter, and the static fields and potentials arising from them. In addition, it introduces the mathematical tools that we will use throughout the sequence.

This first part of the E&M sequence is itself divided in **two parts,** each of which is further divided into two subparts (Field and Potential):

Chapter 1 Mathematical Foundations: Vector Analysis

Chapter 2 Electrostatics
- -Electric field created by a static and localized distribution of electrical charges
- -Electric potential that give rise to this electric field
- -Energy associated with this distribution of electric charges and Work required to move them
- -Conductors
- -Boundary Conditions at a Surface

Chapter 3 Mathematics of Electrostatics to calculate Potentials V(r) or V(x,y,z)
- -Laplace's Equation
- -Boundary Conditions and Uniqueness Theorems
- -Methods to calculate potentials:
  - the method of Images
  - separation of variables
  - multipole expansion

Chapter 4 Electric Fields in Matter (polarizable medium/ dielectric matter)
- - Polarization
- - Electric field due to polarization
- - Electrical Displacement
- - Polarization Energy in and Force on Dielectrics

Chapter 5 Magnetostatics
- -Magnetic Force from a moving electric charge (Lorentz Force Law)
- -Magnetic Field from a steady current (Biot-Savart Law)
- -Current associated with a magnetic field gradient (Ampere's Law)
- -Magnetic Vector Potential corresponding to a Magnetic Field
- -Boundary Conditions at a Surface

Chapter 6 Magnetic Fields in Matter
- -Magnetization
- -Magnetic Field from a Magnetized Object
- -Applied $\boldsymbol{B}$ and induced $\boldsymbol{H}$ fields
- -Magnetic Susceptibility/Permeability of Matter
- -Ferromagnetism

BOOK
D.J. Griffiths Introduction to Electrodynamics 4th edition, Prentice Hall (1999)
You may also consult R.K.Wangsness, Electromagnetic Fields 2nd edition, John Wiley (1986)

GRADING
Homework 20%
Midterm 25%
3-4 Quizzes 18-20%
Final 40%

FINAL COMPETENCIES
The students should
- be able to explain how electric and magnetic fields arise respectively from a static distribution of localized electric charges or steady state currents.
-they should be able to calculate the potentials from simple distributions of charges or simple current configurations
- they should be able to calculate the electric and magnetic fields corresponding to these potentials
-should also understand and be able to quantitatively characterize the basic electromagnetic properties of dielectrics

IMPORTANT NOTE:
Most if not all lectures will be delivered in-person at the regular class time, MWF from 12:10 to 1pm. A few lectures throughout the semester may however be delivered on-line using Zoom. These would be announced in advance.
A homework assignment will be given each week, usually due the following week.
For best and easiest learning, it is essential that you all read each new chapter in advance of the lectures. This will be tested on very simple quizzes, preceding my covering the material in class.

Prof. Rosi Reed
Physics Bldg. room 406
rjr215@lehigh.edu
Prof. Jean Toulouse
Sherman Fairchild Lab room 208
jt02@lehigh.edu

Please note that class attendance is mandatory (so that we are all on the same page throughout the semester)

Accommodations for Students with Disabilities: Accommodations for Students with Disabilities: If you have a disability for which you are or may be requesting accommodations, please contact both your instructor and the Office of Academic Support Services, Williams Hall, Suite 301 (610-758-4152) as early as possible in the semester. You must have documentation from the Academic Support Services office before accommodations can be granted.