Physics 0175

Winter/Spring 2018 (2184)

Learning Goals (What you will be able to do)

R.P. Devaty

January 7, 2018

Overall

- State, both in words and equations, the laws of electromagnetism. Explain their meanings and give examples of situations to which they apply.
- Recognize and effectively make use of the terminology associated with electromagnetic theory.
- Work with various representations of physical laws, including conceptual, graphical, and equations, and be able to transfer between representations as necessary to analyze and solve specific problems/situations.
- Use relevant mathematics, including vector algebra, vector calculus, systems of linear equations, etc., as a tool express the relevant laws of physics and apply them to specific situations.
- Break up a complex problem or situation into simpler parts.
- Recognize the relevance and make use of other laws of physics, including Newton's Laws and the laws of thermodynamics, along with the laws of electromagnetism, if necessary to analyze and solve a given problem/situation.
- Apply relevant physical laws and mathematics to formulate a strategy and then solve a given problem (towards the goal of recognizing the relevance of the material covered in this course to other fields in science and engineering, and to everyday life, and be able to take advantage of your acquired skills to analyze situations and apply the laws of physics to gain insight and make predictions).

Topic/Chapter Specific

The following list was developed by a departmental committee. I have classified them according to the relevant chapters in the textbook, the 10^{th} edition of Halliday, Resnick and Walker. I will write my own learning objectives as the course proceeds. Note that the book lists learning objectives at the beginning of each section.

Chapter 21: Coulomb's Law

- Use Coulomb's law to calculate the forces between two or more point charges.
- Describe how charge redistributes itself as conductors are touched to insulators, other conductors, and/or grounded.

Chapter 22: Electric Field

- Calculate the electric field due to one or more point charges.
- Integrate to find the electric field due to an extended charge distribution (line, arc, or ring).

- Describe the behavior of a dipole placed in an electric field (in terms of torque and potential energy).

Chapter 23: Gauss's Law

- Find the electric field due to a symmetric extended charge distribution using Gauss's law. Alternately, determine the amount of induced charge on the surface(s) of a conductor.

Chapter 24: Electric Potential

- Calculate the electric potential due to a system of point charges.
- Sketch the electric field and/or potential for a charge distribution.
- Integrate to determine the electric potential from a continuous charge distribution (line, arc, or ring).
- Use the relationship between electric potential and electric field to convert from one to the other.
- Determine the potential energy of (or the work needed to assemble) a system of charges.

Chapter 25: Capacitors

- Find the energy stored in a capacitor's electric field.
- Describe the effects of dielectrics on capacitors in terms of the electric field, capacitance, and energy stored in the capacitor.
- Determine the charge, capacitance, or voltage of one or more capacitors in series and parallel.

Chapter 26: Current, Resistance, Power

- Convert between current, current density, and drift velocity.
- Apply the definitions of resistance and resistivity, and convert between the two.
- Find the power dissipated by a resistor in a circuit.

Chapter 27: Kirchhoff's Laws, Circuits, RC Circuit

- Apply Kirchhoff's laws to a single-loop or multi-loop circuit to find the current(s). Circuits may include ideal or real batteries.
- Calculate the voltage between two points in a circuit.
- Determine the equivalent resistance, current, or voltage for resistors in series and parallel.
- Find the time constant, current, and/or voltage of a capacitor in an RC circuit at a particular time.

Chapter 28: Magnetic Field and Magnetic Force

- Find the force on a moving charged particle due to a magnetic field.
- Apply the ideas of crossed fields and/or centripetal motion to solve for an unknown given a set of measurable quantities. Examples include Tompson's apparatus and the Hall effect.

Chapter 29: Calculating the Magnetic Field: Biot-Savart Law, Ampere's Law

- Determine the magnitude and direction of the force acting on current carrying wires.
- Calculate the magnetic field of one or more wires (including solenoids and toroids) using the Biot-Savart Law or Ampere's Law.

- Sketch the magnetic field of one or more wires (including solenoids and toroids).

Chapter 30: Faraday's Law of Induction; Inductors; RL, LC and RLC Circuits

- Calculate the magnitude and direction of an induced current from a changing magnetic flux.
- Determine the inductance or mutual inductance of a system.
- Find the current at a particular time in an RL circuit.
- Calculate the energy stored in the capacitor/inductor in an LC or undriven RLC circuit.

Chapter 31: Series RLC Circuit, Phasor Method, Transformers

- Find resistance, capacitance, inductance, reactance, impedance, phase angle, power factor, current amplitude, and/or voltage amplitude in an RLC circuit.
- Know the relationships between phase, resonance, and terms like "capacitive."
- Determine the average power produced by a generator and/or dissipated by one or more resistive loads.
- Calculate the voltage, current, and/or equivalent resistance transformations of an ideal transformer and identify the circumstances where maximum power is transferred from a source to a load.

Chapter 32: Displacement Current, Maxwell's Equations

- Calculate the displacement current and/or induced magnetic field from a changing electric flux.

Chapter 33: Electromagnetic Waves, Reflection and Refraction, Polarization

- Determine the energy transported by an electromagnetic wave and/or the amplitudes of the electric and magnetic fields.
- Calculate the angle of reflected and/or refracted light rays, and identify total internal reflection.
- Evaluate the intensity of a light source after it passes through one or more polarizers. The light source could be polarized by reflection at Brewster's angle.

Chapter 35: Interference: Double Slit, Thin Film

- Locate the maxima or minima caused by double-slit interference (could be combined with diffraction).
- Calculate the effects of interference from a thin film.