Physics 2140 Exam 3 Outline

Magnetism

- Magnetic N and S poles: how do they interact?
- No magnetic monopoles
- What direction does a magnetic field point?
- Tesla
- Magnetic field of a bar magnet
- Magnetic field of the Earth
- Force of a magnetic field on a moving charge
- Right-hand rule (RHR) for cross-products
- $\odot$ and $\otimes$
- Cross-products with unit vectors
- Charges move in circles/helices in a magnetic field (in what direction?)
- Magnetic field lines can trap charged particles
- Force of magnetic field on a current
- $\vec{L}$ (for current) and $\vec{A}$ (for current loop)
- Torque on a current loop
- Magnetic dipole moment $\vec{\mu}$ of a loop and of a magnet
- How a current loop orients itself in a magnetic field
- Paramagnets, diamagnets, and ferromagnets
- Magnetic field created by a wire
- Biot-Savart Law
- Direction of the magnetic field created by a loop
- Field of a long straight wire $\mu_0 I/2\pi d$
- Field along axis of a circular loop of wire
- μ for a material versus μ_0
- Field of an infinite solenoid

Induction

- Lenz's Law: four questions
- Magnetic flux
- Original flux
- Flux can change when B, overlap area, or angle change
- Faraday's Law
- Generator
- Eddy currents

Equations

(make sure you know what these letters mean!)

$$\vec{F} = q\vec{v} \times \vec{B}$$

$$|\vec{F}| = qvB\sin\phi$$

$$|\vec{F}| = qv_\perp B$$

$$r = \frac{mv}{qB}$$

$$T = \frac{2\pi m}{qB}$$

$$f = 1/T = \frac{qB}{2\pi m}$$

$$\omega = 2\pi f$$

$$\vec{F} = I\vec{L} \times \vec{B}$$

$$\tau = I\vec{A} \times \vec{B}$$

$$\vec{\mu} = I\vec{A}$$

$$d\vec{B} = \frac{\mu_0}{4\pi} I \frac{d\vec{s} \times \vec{d}}{d^3}$$

$$\mu_0 = 4\pi \times 10^{-7}\,\mathrm{Tm/A}$$

$$\epsilon_0 = 8.85 \times 10^{-12} \frac{\mathrm{C}^2}{\mathrm{Nm}^2}$$

$$B \approx \frac{\mu_0 I}{2\pi d}$$

$$\vec{B} = \frac{\mu_0 \vec{\mu}}{2\pi d^3}$$

$$B = \mu_o I n$$

$$\Phi = BA_{\mathrm{overlap}}\cos\phi$$

$$\mathscr{E} = \left| \frac{d\Phi_0}{dt} \right|$$

AC Circuits

- RC Circuits: charging or discharging
- Time constant of RC current and what it means
- Inductors and inductance
- Potential difference across an inductor
- Henries (H)
- Alternating current
- Peak voltage
- Angular frequency
- Impedance Z
- Reactance X
- current leading or lagging voltage
- Resonant frequency in RLC circuit and what it means
- RMS current and voltage
- Transformers

Note: you are not responsible for derivations done in class.

RC Circuits

$$Q(t) = C\mathscr{E}(1 - e^{-t/RC})$$

$$I(t) = \frac{\mathscr{E}}{R}e^{-t/RC}$$

RLC Circuits

$$\Delta V_L = -L\frac{dI}{dt}$$

$$\Delta V_C = \frac{Q}{C}$$

$$\Delta V_R = IR$$

$$\mathscr{E}(t) = \mathscr{E}_0 \cos(\omega t + \phi)$$

$$\mathscr{E}_0 = I_0 Z$$

$$X_C = \frac{1}{\omega C}$$

$$X_L = \omega L$$

$$Z = \sqrt{R^2 + (X_C - X_L)^2}$$

$$\tan\phi = \frac{X_C - X_L}{R}$$

$$\omega_0 = \frac{1}{\sqrt{LC}}$$

$$f_0 = \frac{\omega_0}{2\pi}$$

$$V_S = V_P\frac{N_S}{N_P}$$