Physics 208, Final Exam. Spring 2011

Calculus:

$$\text{If } f(x) = x^n, \text{ then} \qquad \frac{df(x)}{dx} = nx^{n-1}, \qquad \int f(x)dx = \frac{1}{n+1}x^{n+1}$$

$\frac{dy}{dx} + ky = 0$	$\frac{d^2y}{dx^2} + \omega_0^2 y = 0$	$\frac{d^2y}{dx^2} + \frac{2}{\tau}\frac{dy}{dx} + (\omega^2 + \tau^{-2})y = 0$
$y(x) = y_0 e^{-kx}$	$y(x) = y_0 \cos(\omega_0 x + \phi)$	$y_h(x) = y_0 e^{-x/\tau}\cos(\omega x + \phi)$

Coulomb's law:

$$\vec{F} = \frac{\alpha q_1 q_2}{r^2}\hat{r}, \qquad \vec{E} = \frac{\alpha Q}{r^2}\hat{r}, \qquad \phi = \frac{\alpha Q}{r}, \qquad \vec{F} = q\vec{E}, \qquad \Pi = q\phi, \qquad \phi_A - \phi_B = \int_A^B \vec{E}\cdot d\vec{l}$$

Gauss' Law:

$$\Phi_E = \int_{\mathcal{S}} \vec{E}\cdot d\vec{A}, \qquad \oint_{\mathcal{S}} \vec{E}\cdot d\vec{A} = \frac{Q_{enc}}{\epsilon_0}, \qquad \epsilon_0 = \frac{1}{4\pi\alpha}$$

Parallel plate capacitor

$$C = \frac{A\epsilon_0}{d}, \qquad Q = VC, \qquad V = Ed, \qquad E = \frac{\sigma}{\epsilon_0}$$

Charges and currents in magnetic field

$$\vec{F} = q\vec{v}\times\vec{B}, \qquad d\vec{F} = Id\vec{l}\times B, \qquad \vec{M} = I\vec{A}, \qquad \vec{\tau} = \vec{M}\times\vec{B}$$

Ampere's and Biot-Savart laws

$$\oint_\Gamma \vec{B}\cdot d\vec{l} = \mu_0 I + \mu_0\epsilon_0\frac{d}{dt}\int_{\mathcal{S}}\vec{E}\cdot d\vec{A}, \qquad d\vec{B} = \frac{\mu_0 I}{4\pi}\frac{d\vec{l}\times\hat{r}}{r^2}, \qquad B = \mu_0 n I, \qquad B = \frac{\mu_0 I}{2\pi r}$$

Faraday's law

$$\Phi_B = \int_{\mathcal{S}}\vec{B}\cdot d\vec{A}, \qquad \oint_\Gamma \vec{E}\cdot d\vec{l} = -\frac{d}{dt}\int_{\mathcal{S}}\vec{B}\cdot d\vec{A}, \qquad V_{emf} = -\frac{d\Phi_B}{dt}$$

Electric and magnetic field energy density, energy of capacitor and inductor

$$\mathcal{E}_E = \frac{\epsilon_0 E^2}{2}, \qquad \mathcal{E}_B = \frac{B^2}{2\mu_0}, \qquad \mathcal{E}_C = \frac{CV^2}{2} = \frac{Q^2}{2C}, \qquad \mathcal{E}_L = \frac{LI^2}{2}$$

Current, Ohm's law, resistance, resistivity, and conductivity

$$\vec{j} = en\vec{v}, \qquad I = \vec{j}\cdot\vec{A}, \qquad V = IR, \qquad R = \frac{\rho l}{A}, \qquad \vec{j} = \sigma\vec{E}$$

Electric circuits

$$R_{series} = R_1 + R_2 + \ldots, \quad R_{parallel}^{-1} = R_1^{-1} + R_2^{-1} + \ldots, \quad C_{parallel} = C_1 + C_2 + \ldots, \quad C_{series}^{-1} = C_1^{-1} + C_2^{-1} + \ldots$$

$$V_C = \frac{Q}{C}, \qquad V_L = -L\frac{dI}{dt}, \qquad V_R = IR$$