Electric Force, Fields, Charges and Gauss's Law:

$\vec{F}_{12} = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r^2}\hat{r}$ $\quad \vec{E} = \frac{\vec{F}_{on\,q'}}{q'} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\hat{r}$ $\quad \vec{E} = \frac{1}{4\pi\epsilon_0}\int \frac{\hat{r}}{r^2}\,dq$

$\vec{F} = q\vec{E}$ $\quad \vec{\tau} = \vec{p}\times\vec{E}$ $\quad p = qs$ $\quad \Phi_E = \vec{E}\cdot\vec{A}$ $\quad \Phi_E = \oint \vec{E}\cdot d\vec{A} = \frac{q}{\epsilon_0}$

Electric Potential, Energy, Potential and Field:

$E_s = -\frac{dV}{ds}$ $\quad \Delta U = q\Delta V$ $\quad \Delta V = -\int_A^B \vec{E}\cdot d\vec{s}$ $\quad V = \frac{1}{4\pi\epsilon_0}\frac{q}{r}$ $\quad V = \frac{1}{4\pi\epsilon_0}\int \frac{dq}{r}$

$q = C\Delta V$ $\quad U = \frac{1}{2}\frac{Q^2}{C} = \frac{1}{2}C(\Delta V)^2$ $\quad C_{eq} = C_1 + C_2$ $\quad \frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2}$

$\epsilon = \kappa\epsilon_0$ $\quad u_E = \frac{1}{2}\epsilon_0 E^2$ $\quad E = \frac{\eta}{\epsilon_0}$ $\quad U = \frac{1}{4\pi\epsilon_0}\frac{q_1 q_2}{r}$ $\quad p = qs$ $\quad U = -pE\cos\theta = -\vec{p}\cdot\vec{E}$

Electric current, Resistance and Fundamentals of Circuits:

$I = \frac{dQ}{dt}$ $\quad I = \frac{ne^2\tau A}{m}E$ $\quad \vec{J} = \frac{I}{A} = \frac{ne^2\tau}{m}\vec{E}$ $\quad v_d = \frac{J}{nq}$ $\quad \sum I_{in} = \sum I_{out}$

$\sigma = \frac{ne^2\tau}{m}$ $\quad \vec{J} = \sigma\vec{E}$ $\quad I = \frac{\Delta V}{R}$ $\quad R = \frac{\rho\ell}{A}$ $\quad P = I^2 R = \frac{(\Delta V)^2}{R}$

$R_{eq} = R_1 + R_2$ $\quad \frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$ $\quad \sum I = 0$ $\quad \sum V = 0$ $\quad Q(t) = Q_0 e^{-\frac{1}{RC}t}$

$Q(t) = -C\mathcal{E}\left(e^{-\frac{t}{RC}} - 1\right) = Q_{max}\left(1 - e^{-\frac{t}{RC}}\right)$

Magnetic Field and Electromagnetic Induction:

$d\vec{B} = \frac{\mu_0}{4\pi}\frac{(dq)\vec{v}\times\hat{r}}{r^2} = \frac{\mu_0}{4\pi}\frac{Id\vec{s}\times\hat{r}}{r^2}$ $\quad \mu_0\epsilon_0 = c^{-2}$ $\quad B = \frac{\mu_0 I}{4\pi}\int\frac{d\vec{s}\times\hat{r}}{r^2}$ $\quad \oint \vec{B}\cdot d\vec{s} = \mu_0 I$

$B = \mu_0 nI$ $\quad \mu \equiv IA$ $\quad \vec{F} = q\vec{v}\times\vec{B}$ $\quad \vec{F} = I\vec{L}\times\vec{B}$ $\quad \vec{\tau} = \vec{\mu}\times\vec{B}$ $\quad \Delta V_{Hall} = \frac{IB}{tne}$

$\Phi_m = \int \vec{B}\cdot d\vec{A}$ $\quad U = -\vec{\mu}\cdot\vec{B}$ $\quad \mathcal{E} = -\frac{d\Phi_m}{dt}$ $\quad L = \frac{N\Phi_m}{I}$ $\quad \mathcal{E} = -L\frac{dI}{dt}$

$I = \frac{\mathcal{E}_0}{R}\left(1 - e^{-\frac{R}{L}t}\right)$ $\quad I = \frac{\mathcal{E}_0}{R}e^{-\frac{R}{L}t}$ $\quad u_B = \frac{B^2}{2\mu_0}$ $\quad V_2 = -M_{12}\frac{dI_1}{dt}$ $\quad \vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$

$L_{eq} = L_1 + L_2$ $\quad \frac{1}{L_{eq}} = \frac{1}{L_1} + \frac{1}{L_2}$

Electromagnetic Waves: $\frac{E_0}{B_0} = \frac{E}{B} = c$ $\quad \vec{S} = \frac{1}{\mu_0}\vec{E}\times\vec{B}$ $\quad p_{rad} = \frac{P}{Ac} = \frac{I}{c} = \frac{S_{avg}}{c}$

$I_{transmitted} = I_0\cos^2\theta$ $\quad I_{transmitted} = \frac{1}{2}I_0$ $\quad v_{em} = \frac{1}{\sqrt{\epsilon_0\mu_0}} = c$

$\oint \vec{E}\cdot d\vec{s} = -\frac{d\Phi_m}{dt}$ $\quad \oint \vec{B}\cdot d\vec{s} = \mu_0 I + \mu_0\epsilon_0\frac{d\Phi_E}{dt}$

$\vec{F} = q(\vec{E} + \vec{v}\times\vec{B})$ $\quad \oint \vec{B}\cdot d\vec{A} = 0$ $\quad I_d = \epsilon_0\frac{d\Phi_E}{dt}$

AC Circuits: $V_R = IR$ $\quad V_L = IX_L$ $\quad V_C = IX_C$

$X_C = \frac{1}{\omega C}$ $\quad X_L = \omega L$ $\quad Z = \sqrt{R^2 + (X_L - X_C)^2}$ $\quad I_{max} = \frac{\mathcal{E}_0}{Z} = I$

$\tan\phi = \frac{X_L - X_C}{R}$ $\quad P_{avg} = \frac{1}{2}\frac{\mathcal{E}_0^2}{Z}\cos\phi$ $\quad \frac{\Delta V_2}{\Delta V_1} = \frac{N_2}{N_1}$ $\quad \omega = \frac{1}{\sqrt{LC}}$

Traveling waves: $y(x,t) = A\sin(kx - \omega t + \phi_0)$ $\quad v = \sqrt{T_s/\mu}$ $\quad k = \frac{2\pi}{\lambda}$

$\omega = 2\pi f = \frac{2\pi}{T}$ $\quad P_{avg} = \frac{1}{2}\mu\omega^2 A^2 v$ $\quad f_{\pm} = \frac{v \pm v_o}{v \mp v_s}f_0$ $\quad \beta = (10\text{ dB})\log_{10}\left(\frac{I}{I_0}\right)$

Superposition: $\Delta r = m\lambda$ $\quad \Delta r = \left(m + \frac{1}{2}\right)\lambda$ $\quad \Delta\phi = 2\pi\frac{\Delta r}{\lambda} + \Delta\phi_0 = \left(m + \frac{1}{2}\right)2\pi$

$A = 2a\sin(kx)$ $\quad f_n = n\frac{v}{2L}$ $\quad v = f\lambda$ $\quad f_n = n\frac{v}{4L}$ $\quad f_b = |f_1 - f_2|$

$\Delta\phi = 2\pi\frac{\Delta r}{\lambda} + \Delta\phi_0 = m2\pi$

Wave Optics: $m\lambda = d\sin\theta$ $\quad y_{max} = y_m = \frac{m\lambda L}{d}$

$I = 4I_1\cos^2\left(\frac{\pi dy}{\lambda L}\right)$ $\quad a\sin\theta_P = p\lambda$ $\quad \theta_{min} = \frac{\lambda}{a}$ $\quad \theta_{\min(1)} = \frac{1.22\lambda}{D}$

Ray Optics: $\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$ $\quad n_1\sin\theta_1 = n_2\sin\theta_2$ $\quad \frac{1}{f} = (n-1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$ $\quad f = \frac{R}{2}$ $\quad m = -\frac{s'}{s}$

Optical Instruments: $f\text{-number} = \frac{f}{D}$ $\quad I \propto \frac{1}{(f\text{-number})^2}$ $\quad P = \frac{1}{f}$ $\quad M = -\frac{f_{obj}}{f_{eye}}$