EECE 380

$\vec{J} = \rho_v \vec{u}$ $\quad \vec{F} = \frac{q_1 q_2}{4\pi\varepsilon R^2}\hat{R}$ $\quad C = \frac{\epsilon A}{d}$ $\quad R = \frac{l}{\sigma A}$ $\quad \vec{F} = q\vec{E}$ $\quad \varepsilon_r = 1 + X_e$ $\quad \mu_r = 1 + X_m$

$\nabla \times \vec{H} = \vec{J}$ $\quad G = \frac{2\pi\sigma l}{ln(b/a)}$ $\quad C = \frac{2\pi\varepsilon l}{ln(b/a)}$ $\quad L = \frac{\mu l}{2\pi} ln(b/a)$ $\quad \vec{E} = \sum \frac{Q_i}{4\pi\varepsilon|R_i^3|}\vec{R_i}$

$\vec{E} = \int \frac{dq}{4\pi\varepsilon R^2}\hat{R}$ $\quad L = \mu\frac{N^2}{l}\pi a^2$ $\quad \vec{E} = \frac{\rho_l}{2\pi\varepsilon h}\frac{l/2}{\sqrt{(l/2)^2+h^2}}\vec{z}$ $\quad \vec{E} = \frac{\rho_l \times a \times z}{2\varepsilon(a^2+z^2)^{1.5}}\vec{z}$

$\vec{E} = \frac{\rho_s}{2\varepsilon}\left(1 - \frac{h}{\sqrt{a^2+h^2}}\right)\vec{z}$ $\quad \vec{E} = \frac{qd}{4\pi\varepsilon R^3}(2cos\theta\, \hat{R} + sin\theta\, \hat{\theta})$ $\quad \rho_v = \nabla.\vec{D}$

$V_A - V_B = -\int_B^A \vec{E}.\vec{dl}$ $\quad \vec{E} = -\nabla V$ $\quad V = \sum \frac{Q_i}{4\pi\varepsilon|\vec{R_i}|}$ $\quad V = \int \frac{dq}{4\pi\varepsilon R}$ $\quad \nabla^2 V = -\frac{\rho_s}{\varepsilon}$

$\vec{v_e} = -\mu_e\vec{E}$ $\quad \vec{v_h} = \mu_h \vec{E}$ $\quad J = qn\mu_n + qp\mu_p$ $\quad \rho_{v_e} = -\frac{\sigma}{\mu_e}$ $\quad N_e = -\frac{\rho_{v_e}}{q}$

$R = \frac{-\int \vec{E}.\vec{dl}}{\iint \sigma\vec{E}.\vec{dS}}$ $\quad C = \frac{\iint \varepsilon\vec{E}.\vec{dS}}{-\int \vec{E}.\vec{dl}}$ $\quad P = \iiint \vec{E}.\vec{J}dV$ $\quad W_e = \frac{1}{2}\iiint \vec{D}.\vec{E}dV$ $\quad W = Q(V_B - V_A)$

$\vec{M} = X_m\vec{H}$ $\quad \vec{F_{EM}} = q(\vec{E} + \vec{u}\times\vec{B})$ $\quad \frac{dW}{dt} = \vec{F_m}.\vec{u}$ $\quad \vec{T} = \vec{m}\times\vec{B}$ $\quad \vec{m} = NIA\hat{n}$

$\vec{T} = \vec{d}\times\vec{F}$ $\quad n = N/l$ $\quad \vec{H} = \frac{1}{4\pi}\iint \frac{\vec{J_s}\times\hat{R}}{R^2}dS = \frac{1}{4\pi}\iiint\frac{\vec{J_v}\times\hat{R}}{R^2}dV = \int\frac{I}{4\pi}\frac{\vec{dl}\times\hat{R}}{R^2}$

$\vec{H} = \frac{I}{4\pi r}(cos\theta_d - cos\theta_u)\vec{a_\varphi}$ $\quad \vec{H} = \frac{I\varphi}{4\pi a}\vec{z}$ $\quad \vec{H} = \frac{Ia^2}{2(a^2+z^2)^{1.5}}\vec{z}$

$\vec{H} = \frac{\mu n I}{2}(sin\theta_2 - sin\theta_1)\vec{z}$ $\quad \vec{H} = \frac{m}{4\pi R^3}(2cos\theta\, \hat{R} + sin\theta\, \hat{\theta})$

$\vec{H} = -\frac{NI}{2\pi r}\vec{a_\varphi}$ $\quad \vec{H} = \pm\frac{J_s}{2}\vec{y}$ $\quad \vec{F'} = \frac{\vec{F}}{l} = \frac{\mu I_1 I_2}{2\pi d}\hat{R}$ $\quad \vec{B} = \nabla\times\vec{A}$

$\nabla^2\vec{A} = -\mu\vec{J}$ $\quad \Lambda = N\varphi$ $\quad L = \frac{\Lambda}{I}$ $\quad \vec{A} = \frac{\mu}{4\pi}\iiint\frac{\vec{J}}{R}dV = \frac{\mu}{4\pi}\int\frac{I}{R}\vec{dl}$ $\quad W_m = \frac{1}{2}\iiint\vec{B}.\vec{H}dV$

Maxwell's: $\nabla.\vec{D} = \rho_v$ $\quad \nabla.\vec{B} = 0$ $\quad \nabla\times\vec{E} = -\frac{d\vec{B}}{dt}$ $\quad \nabla\times\vec{H} = \vec{J} + \frac{d\vec{D}}{dt}$

$V_{emf} = V_{emf}{}^{Tr} + V_{emf}{}^{m}$ $\quad V_{emf}{}^{Tr} = -N\frac{d\varphi_m}{dt}$ $\quad V_{emf}{}^{m}{}_{ab} = \oint_b^a(\vec{u}\times\vec{B}).\vec{dl}$

$I_d = \iint\vec{J_d}.\vec{dS} = \iint\frac{d\vec{D}}{dt}\vec{dS}$ $\quad I_d = C\frac{dV}{dt}$ $\quad I_c = \iint\vec{J_c}.\vec{dS}$ $\quad \oint\vec{H}.\vec{dl} = I_c + I_d$

Electromagnetic Generator: $\varphi = AB_o\cos(wt + C_o)$ $\quad \nabla.\vec{J} = -\frac{d\rho_v}{dt}$ $\quad \oiint\vec{J}.\vec{dS} + \frac{dQ}{dt} = 0$

Boundary: $E_{t1} = E_{t2}$ $\quad \hat{n}.(\vec{D_1} - \vec{D_2}) = \rho_s$ $\quad B_{n1} = B_{n2}$ $\quad \hat{n}\times(\vec{H_1} - \vec{H_2}) = \vec{J_s}$

Electromagnetic Potential: $\vec{E} = -\nabla V - \frac{d\vec{A}}{dt}$ $\quad \vec{B} = \nabla\times\vec{A}$ $\quad u_p = \lambda f = \frac{1}{\sqrt{\mu\varepsilon}} = \frac{w}{\beta} = \frac{c}{\sqrt{\varepsilon_r}}$

$E(z,t) = E_o e^{-\alpha z}\cos(wt - \beta z + \varphi)$ $\quad \varepsilon_c = \varepsilon' - j\varepsilon''$ $\quad \varepsilon'' = \frac{\sigma}{w}$ $\quad \gamma = jw\sqrt{\mu\varepsilon}$

$k = w\sqrt{\mu\varepsilon}$ $\quad \eta = \sqrt{\frac{\mu}{\varepsilon}}$ $\quad \nabla^2\bar{E} - \gamma^2\bar{E} = 0$ $\quad \vec{H} = \frac{1}{\eta}\hat{k}\times\vec{E}$ $\quad \vec{E} = -\eta\hat{k}\times\vec{H}$

$\bar{E} = E_o{}^+ e^{-\gamma z} + E_o{}^- e^{+\gamma z}$ $\quad Z_o = \frac{V_o^+}{I_o^+} = -\frac{V_o^-}{I_o^-} = \sqrt{\frac{R'+jwL'}{G'+jwC'}}$ $\quad SWR = \frac{1+|\Gamma_L|}{1-|\Gamma_L|} = \frac{|\widetilde{V(z)}|_{MAX}}{|\widetilde{V(z)}|_{MIN}}$

Angle: $\psi(z,t) = \tan^{-1}\left(\frac{E_y(z,t)}{E_x(z,t)}\right)$ LHC: $\psi = -(wt \pm kz)$ RHC: $\psi = +(wt \pm kz)$

$\gamma = \alpha + j\beta = \sqrt{(R'+jwL')(G'+jwC')}$ $\quad \Gamma_L = \frac{Z_L - Z_o}{Z_L+Z_o} = |\Gamma_L|e^{j\theta_r}$ $\quad \Gamma_L = \frac{V_o^-}{V_o^+} = -\frac{I_o^-}{I_o^+}$

$|\widetilde{V(z)}| = |V_o{}^+|\sqrt{|\Gamma_L|^2 + 1 + 2|\Gamma_L|\cos(2\beta z + \theta_r)}$ $\quad Z_{in}(-l) = Z_o\frac{Z_L + jZ_o\tan\beta l}{Z_o + jZ_L\tan\beta l}$