ECE 4391 Quiz 3 Formula Sheet

$$\mu_0 = 4\pi \times 10^{-7} \qquad \epsilon_0 = 8.85 \times 10^{-12} \qquad \sigma_{\text{cu}} = 5.82 \times 10^7 \qquad Z_w = E/H$$

$$Z_0 = \sqrt{j\omega\mu/(\sigma + j\omega\epsilon)} \qquad Z_0 = \sqrt{\mu/\epsilon} \qquad Z_0 = 377 \qquad Z_s = \sqrt{\omega\mu/(2\sigma)}\,(1+j)$$

$$|Z_s| = 3.68 \times 10^{-7}\sqrt{\mu_r/\sigma_r}\sqrt{f} \qquad S = 20\log(E_0/E_1) \qquad S = 20\log(H_0/H_1)$$

$$S = A + R + B \qquad E_1 = E_0\exp(-t/\delta) \qquad H_1 = H_0\exp(-t/\delta)$$

$$\delta = \sqrt{2/(\omega\mu\sigma)} \qquad \delta_{\text{inches}} = 2.6/\sqrt{f\mu_r\sigma_r}$$

$$A = 20\,(t/\delta)\log e = 8.69\,(t/\delta) = 3.34 t_{\text{inches}}\sqrt{f\mu_r\sigma_r}$$

$$E_1 = E_0 \times 2Z_2/(Z_1 + Z_2) \qquad H_1 = H_0 \times 2Z_1/(Z_1 + Z_2)$$

$$E_r = E_0 \times (Z_2 - Z_1)/(Z_2 + Z_1) \qquad H_r = H_0 \times (Z_1 - Z_2)/(Z_2 + Z_1)$$

$$E_t = E_1 \times 2Z_1/(Z_1 + Z_2) = E_0 \times 4Z_1Z_2/(Z_1 + Z_2)^2 \simeq E_0 \times 4Z_2/Z_1$$

$$H_t = H_1 \times 2Z_1/(Z_2 + Z_1) = H_0 \times 4Z_1Z_2/(Z_1 + Z_2)^2 \simeq H_0 \times 4Z_2/Z_1$$

$$R = 20\log\left[|Z_w|/(4\,|Z_s|)\right] = 20\log(94.25/|Z_s|) = 168 + 10\log\left[\sigma_r/(\mu_r f)\right]$$

$$|Z_w|_e = 1/(2\pi f\epsilon r) \qquad |Z_w|_m = 2\pi f\mu r$$

$$R_e = 20\log\left[1/(8\pi f\epsilon r\,|Z_s|)\right] = 20\log\left[4.5 \times 10^9/(fr\,|Z_s|)\right] = 322 + 10\log\left[\sigma_r/\left(\mu_r f^3 r^2\right)\right]$$

$$R_m = 20\log\left[2\pi f\mu r/(4\,|Z_s|)\right] = 20\log\left(1.97 \times 10^{-6} fr/|Z_s|\right) = 14.6 + 10\log\left[fr^2\sigma_r/\mu_r\right]$$

$$B = 20\log\left[1 - \exp(-2t/\delta)\right] \qquad S = 20\log\left[\lambda/(2\ell)\right] \qquad S = -10\log n$$

$$f_{c(\text{round})} = 6.9 \times 10^9/d \qquad S_{(\text{round})} = 32t/d \qquad f_{c(\text{rect})} = 5.9 \times 10^9/\ell \qquad S_{(\text{rect})} = 27.2t/\ell$$

$$f_{0(\text{cavity})} = 212/\ell \qquad v = L\,(di/dt) \qquad V_{\text{dc}}/I_a < R < R_L \qquad V_{C(\text{peak})} = I_0\sqrt{L/C}$$

$$C \geq (I_0/300)^2\,L \qquad C \geq I_0 \times 10^{-6} \qquad C \geq 4L/R_1^2 \qquad R \geq 10V_{\text{dc}}/I_A$$

$$V_T = 0.025 \qquad 4kT_0 = 1.6 \times 10^{-20} \qquad q = 1.6 \times 10^{-19} \qquad k = 1.38 \times 10^{-23}$$

$$V_t = \sqrt{4kT\,\text{Re}\,(Z)\,B} \qquad S_v(f) = V_t^2/B \qquad I_t = \sqrt{4kT\,\text{Re}\left(\frac{1}{Z}\right)B} \qquad S_i(f) = I_t^2/B$$

$$B = |A_0|^{-2}\int_0^\infty |A(f)|^2\,df \qquad B = \pi f_{3\text{dB}}/2 \qquad f_{3\text{dB}} = f_0/Q$$

$$I_{sh} = \sqrt{2qI_{\text{dc}}B} \qquad S_i(f) = I_{sh}^2/B \qquad I_f = \sqrt{K_f I_{\text{dc}}^m B/f^n} \qquad S_i(f) = I_f^2/B$$

$$V_{\text{sum}} = \sqrt{V_1^2 + 2\gamma V_1V_2 + V_2^2} \qquad V_{\text{total}} = \sqrt{V_1^2 + V_2^2 + \cdots + V_m^2} \text{ when } \gamma_i = 0$$