Physics 471 Final Exam Winter 2009

Closed book.

Name ________________

$\varepsilon_o = 8.854\times10^{-12}\ \mathrm{C^2/N\cdot m^2}$

$\mu_o = 4\pi\times10^{-7}\ \mathrm{T\cdot m/A}$

$$\vec\nabla\cdot\vec E = \frac{\rho}{\varepsilon_o}$$

$$\vec\nabla\cdot\vec B = 0$$

$$\vec\nabla\times\vec E + \frac{\partial\vec B}{\partial t} = 0$$

$$\vec\nabla\times\frac{\vec B}{\mu_o} - \varepsilon_o\frac{\partial\vec E}{\partial t} = \vec J$$

$$\nabla^2\vec E - \mu_o\varepsilon\frac{\partial^2\vec E}{\partial t^2} = 0$$

$$I(\theta) = \frac{p_0^2\omega^4}{32\pi^2c^3\epsilon_0}\frac{\sin^2\theta}{r^2}$$

$$\frac{\partial^2x}{\partial t^2} + \gamma\frac{\partial x}{\partial t} + \omega_o{}^2x = \frac{q}{m}E_oe^{i\omega t}$$

$$\vec P(\omega) = q_\mathrm{e}N\vec x = (\varepsilon-\varepsilon_o)\vec E(\omega)$$

$$\vec P(\omega) = \frac{q_\mathrm{e}^2N}{m_\mathrm{e}}\frac{1}{\omega_o^2-\omega^2-i\omega\gamma}\vec E(\omega)$$

$$\tilde n = \sqrt{\tilde K}$$

$$I(z) = I_oe^{-\alpha z}$$

$$\vec S \equiv \vec E\times\frac{\vec B}{\mu_o}$$

$$I = \frac{n\varepsilon_oc}{2}E_o{}^2$$

$$I = uc$$

$$\vec p = \hbar\vec k$$

$$\mathcal{P} = u$$

$$r_s = \frac{\sin\theta_t\cos\theta_i - \sin\theta_i\cos\theta_t}{\sin\theta_t\cos\theta_i + \sin\theta_i\cos\theta_t} = -\frac{\sin(\theta_i-\theta_t)}{\sin(\theta_i+\theta_t)} = \frac{n_i\cos\theta_i - n_t\cos\theta_t}{n_i\cos\theta_i + n_t\cos\theta_t}$$

$$t_s = \frac{2\sin\theta_t\cos\theta_i}{\sin\theta_t\cos\theta_i + \sin\theta_i\cos\theta_t} = \frac{2\sin\theta_t\cos\theta_i}{\sin(\theta_i+\theta_t)} = \frac{2n_i\cos\theta_i}{n_i\cos\theta_i + n_t\cos\theta_t}$$

$$r_p = \frac{\cos\theta_i\sin\theta_i - \cos\theta_t\sin\theta_t}{\cos\theta_t\sin\theta_t + \cos\theta_i\sin\theta_i} = \frac{\tan(\theta_i-\theta_t)}{\tan(\theta_i+\theta_t)} = \frac{n_t\cos\theta_i - n_i\cos\theta_t}{n_i\cos\theta_t + n_t\cos\theta_i}$$

$$t_p = \frac{2\cos\theta_i\sin\theta_t}{\cos\theta_t\sin\theta_t + \cos\theta_i\sin\theta_i} = \frac{2\cos\theta_i\sin\theta_t}{\sin(\theta_i+\theta_t)\cos(\theta_i-\theta_t)} = \frac{2n_i\cos\theta_i}{n_i\cos\theta_t + n_t\cos\theta_i}$$

$$T = \frac{n_t\cos\theta_t}{n_i\cos\theta_i}|t|^2$$

$\varepsilon_o = 8.854\times10^{-12}\ \mathrm{C^2/N\cdot m^2}$

$\mu_o = 4\pi\times10^{-7}\ \mathrm{T\cdot m/A}$

$c = 2.9979\times10^8\ \mathrm{m/s}$

$q_\mathrm{e} = 1.602\times10^{-19}\mathrm{C}$

$m_\mathrm{e} = 9.108\times10^{-31}\mathrm{kg}$

$k_\mathrm{B} = 1.380\times10^{-23}\ \mathrm{J/K}$

$h = 6.626\times10^{-34}\mathrm{J\cdot s}$

$\hbar = h/2\pi = 1.054\times10^{-34}\mathrm{J\cdot s}$

$\sigma = 5.670\times10^{-8}\ \mathrm{W/m^2\cdot K^4}$

$$R.A. = 2\tan\theta_{\max} = \frac{D}{f}$$

$$\frac{n_1}{s_o} + \frac{n_2}{s_i} = \frac{n_2 - n_1}{R}$$

$$\frac{1}{f} = (n_l - 1)\left(\frac{1}{R_1} + \frac{1}{R_2}\right)$$

$$M_L = -M_t^2$$

$$\begin{pmatrix} 1 & d \\ 0 & 1 \end{pmatrix} \quad \begin{pmatrix} 1 & 0 \\ -2/|R| & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ (n_i/n_t - 1)/R & n_i/n_t \end{pmatrix} \quad \begin{pmatrix} 1 & 0 \\ -1/f & 1 \end{pmatrix}$$

$$A + p_2 C = 1 \qquad p_1 C + D = 1 \qquad -1 < \frac{1}{2}(A + D) < 1$$

$$|E_{\text{eff}}| = \sqrt{E_{0x}{}^2 + E_{0y}{}^2}$$

$$\alpha = \frac{1}{2}\tan^{-1}\left[\frac{2E_{0x}E_{0y}\cos\varepsilon}{E_{0x}{}^2 - E_{0y}{}^2}\right]$$

$$E_\alpha = |E_{\text{eff}}|\sqrt{E_{0x}{}^2\cos^2\alpha + E_{0y}{}^2\sin^2\alpha + E_{0x}E_{0y}\cos\varepsilon\sin 2\alpha}$$

$$E_{\alpha\pm\pi/2} = |E_{\text{eff}}|\sqrt{E_{0x}{}^2\sin^2\alpha + E_{0y}{}^2\cos^2\alpha - E_{0x}E_{0y}\cos\varepsilon\sin 2\alpha}$$

$$n = \frac{n_o n_e}{\sqrt{n_o^2\sin^2\phi + n_e^2\cos^2\phi}} \qquad \tan\phi' \equiv \frac{S_y}{S_z} = \frac{n_o^2}{n_e^2}\tan\phi$$

$$\begin{bmatrix} \cos^2\theta & \sin\theta\cos\theta \\ \sin\theta\cos\theta & \sin^2\theta \end{bmatrix} \begin{bmatrix} \cos 2\theta & \sin 2\theta \\ \sin 2\theta & -\cos 2\theta \end{bmatrix}$$

$$\begin{bmatrix} \cos^2\theta + i\sin^2\theta & \sin\theta\cos\theta - i\sin\theta\cos\theta \\ \sin\theta\cos\theta - i\sin\theta\cos\theta & \sin^2\theta + i\cos^2\theta \end{bmatrix}$$

$$\begin{bmatrix} E_{\text{I}} \\ H_{\text{I}} \end{bmatrix} = \begin{bmatrix} \cos k_0 h & (i\sin k_0 h)/\Upsilon_1 \\ \Upsilon_1 i\sin k_0 h & \cos k_0 h \end{bmatrix} \begin{bmatrix} E_{\text{II}} \\ H_{\text{II}} \end{bmatrix} \qquad h \equiv nd\cos\theta$$

$$\Upsilon_1 \equiv \sqrt{\frac{\epsilon_0}{\mu_0}}\, n_1 \cos\theta_{i\text{II}}$$

$$r = \frac{\Upsilon_0 m_{11} + \Upsilon_0\Upsilon_s m_{12} - m_{21} - \Upsilon_s m_{22}}{\Upsilon_0 m_{11} + \Upsilon_0\Upsilon_s m_{12} + m_{21} + \Upsilon_s m_{22}}$$

$$t = \frac{2\Upsilon_0}{\Upsilon_0 m_{11} + \Upsilon_0\Upsilon_s m_{12} + m_{21} + \Upsilon_s m_{22}}$$

$$E = C\iint E(y,z)\frac{e^{ikr}}{r}\,dydz$$

For any transform pair: $t, \omega \qquad x, \kappa$

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$$f(x)=\frac{1}{2\pi}\int_{-\infty}^{\infty}F(\kappa)e^{-i\kappa x}d\kappa$$

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$$\delta(x-x_o)=\frac{1}{2\pi}\int_{-\infty}^{\infty}e^{-ik(x-x_o)}dk$$

$$\delta(\kappa-\kappa_o)=\frac{1}{2\pi}\int_{-\infty}^{\infty}e^{-ix(\kappa-\kappa_o)}dx$$

$$\kappa=k\sin\theta\approx k\,\_\_\_\_\approx k\,\_\_\_\_\_$$

$$(g*h)(u)=\int_{-\infty}^{\infty}g(u')h(u-u')du' \quad F\left\{(g*h)(t)\right\}=g(\omega)h(\omega) \quad F\left\{g(t)h(t)\right\}=\frac{1}{2\pi}g(\omega)*h(\omega)$$

$$I(\kappa)=\frac{I_{\text{peak}}}{N^2}\left|\frac{\sin\left(\frac{\kappa b}{2}\right)}{\frac{\kappa b}{2}}\right|^2\frac{\sin^2\left(\frac{N\kappa a}{2}\right)}{\sin^2\left(\frac{\kappa a}{2}\right)} \qquad I(\theta)=I_o\left[\frac{J_1(\kappa D/2)}{\kappa D/2}\right]^2$$

$$\sum_{n=1}^{N}u^n=u\frac{u^N-1}{u-1}$$

$$V=\frac{I_{\max}-I_{\min}}{I_{\max}+I_{\min}}$$

$$I_{\det}(\tau)=2I_1\left[1+\gamma(\tau)\right] \qquad \gamma(\tau)\equiv\frac{\int_{-\infty}^{\infty}d\omega I(\omega)e^{i\omega\tau}}{\int_{-\infty}^{\infty}I(\omega)d\omega} \qquad \left|\gamma(a)\right|\equiv\left|\frac{\int_{-\infty}^{\infty}I(\theta')e^{-ika\theta'}d\theta'}{\int_{-\infty}^{\infty}I(\theta')d\theta'}\right|$$