P214 Formula Sheets: Prelim II

Complex numbers

$$e^{ix} = \cos(x) + i\sin(x)$$
$$|\underline{A}|^2 = A_r^2 + A_i^2 = \underline{A}^*\underline{A}$$

Basic wave relationships

$$f = 1/T \quad \omega = 2\pi f$$
$$\omega = 2\pi/T \quad k = 2\pi/\lambda$$
$$c = \lambda f \quad c = \omega/k$$

Wave physics

Quantity	String	Sound	E&M
Dynamical law(s)	$F_y = \pm\tau\frac{\partial y}{\partial x}$	$P = P_o - B\frac{\partial s}{\partial x}$	$\begin{cases} \frac{\partial E_y}{\partial x} = -\frac{\partial B_z}{\partial t} \\ \frac{\partial B_z}{\partial x} = -\mu_0\epsilon_0\frac{\partial E_y}{\partial t} \end{cases}$
Wave equation	$\tau\frac{\partial^2 y}{\partial x^2} = \mu\frac{\partial^2 y}{\partial t^2}$	$B\frac{\partial^2 s}{\partial x^2} = \rho\frac{\partial^2 s}{\partial t^2}$	$\frac{1}{\mu_0}\frac{\partial^2 E_y}{\partial x^2} = \epsilon_0\frac{\partial^2 E_y}{\partial t^2}$

Electromagnetic Waves in Vacuum

Relative Field strengths: $|\vec{E}| = c|\vec{B}|$ (for a plane wave)

Direction of propagation: $\vec{E} \times \vec{B}$

Wave equation and solutions

$$c^2\frac{\partial^2 y}{\partial x^2} = \frac{\partial^2 y}{\partial t^2}$$
$$\mp c\frac{\partial y}{\partial x} = \frac{\partial y}{\partial t} \quad \text{(pulse Eq.)}$$
$$y(x,t) = f(x - ct) + g(x + ct)$$
$$y(x,t) = h(x + ct) - h(-(x - ct)) \quad \text{reflection from fixed BC}$$
$$y(x,t) = h(x + ct) + h(-(x - ct)) \quad \text{reflection from free BC}$$

Optics

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

Snell's law of refraction: $n_1 sin\theta_1 = n_2 sin\theta_2$