PHYSICS 211: WAVES & OPTICS

Understand and know how to use the following:

EQUATIONS

$k = \frac{2\pi}{\lambda}$, $\omega = \frac{2\pi}{T}$

$v = \lambda f = \lambda/T = \omega/k$

$v = \sqrt{\tau/\mu}$

$y(x,t) = y_m \sin(kx \pm \omega t)$

$P_{avg} = \frac{1}{2}\mu v \omega^2 y_m^2$

$I = P/A = \dfrac{P_s}{4\pi r^2}$

$f = \frac{nv}{2L}, n = 1, 2, 3, \ldots$

$c = 1/\sqrt{\mu_0 \epsilon_0}$

$E = cB$, $\mathbf{S} = \frac{1}{\mu_0}\mathbf{E} \times \mathbf{B}$

$I = \overline{S} = \frac{1}{c\mu_0} E_{rms}^2$, $E_{rms} = E_m/\sqrt{2}$

$\Delta p = \Delta U/c$, $p_r = I/c$, $F = IA/c$

$\Delta p = 2\Delta U/c$, $p_r = 2I/c$, $F = 2IA/c$

$I = \begin{cases} I_0/2 & \text{unpolarized} \\ I_0 \cos^2\theta & \text{polarized} \end{cases}$

$n \equiv \frac{c}{v} = \frac{\lambda_0}{\lambda_n}$, $\theta_1' = \theta_1$, $n_1 \sin\theta_1 = n_2 \sin\theta_2$

$\theta_B = \tan^{-1}\frac{n_2}{n_1}$, $\theta_c = \sin^{-1}\frac{n_2}{n_1}$

$\Delta\phi = \frac{2nL}{\lambda}\cos\theta_n + \begin{cases} 0 & n_2 < n_1 \\ \pi & n_2 > n_1 \end{cases}$

$I = 4I_0 \cos^2\phi, \quad \phi = \dfrac{\pi d}{\lambda}\sin\theta$

$I = I_m \left(\dfrac{\sin\alpha}{\alpha}\right)^2, \quad \alpha = \dfrac{\pi a}{\lambda}\sin\theta$

$I = I_m \left(\dfrac{\sin\alpha}{\alpha}\right)^2 \left(\dfrac{\sin N\phi}{\sin\phi}\right)^2$, N slits

$I = I_m \left(\dfrac{J_1(\beta)}{\beta}\right)^2, \quad \beta = \dfrac{\pi d}{\lambda}\sin\theta$

$\theta_R = \sin^{-1}\dfrac{1.22\lambda}{d}$

$\Delta\theta_{hw} = \dfrac{\lambda}{Nd\cos\theta}$

$D = \Delta\theta/\Delta\lambda = \dfrac{m}{d\cos\theta}$

$R = \lambda_{av}/\Delta\lambda = Nm$

$n = \dfrac{\sin(\psi_{min}/2 + \phi/2)}{\sin(\phi/2)}$

$n_1/p + n_2/i = (n_2 - n_1)/r$

$f = r/2, \quad 1/f = (n-1)(1/r_1 - 1/r_2)$

$1/p + 1/i = 1/f$

$|m| \equiv \dfrac{h'}{h}, \quad m = -\dfrac{i}{p}$

UNITS & CONSTANTS

s = second

m = meter

kg = kilogram

N = Newton = kg·m/s^2

J = Joule = N·m

C = Coulomb

V = Volt = J/C

A = Ampere = C/s

W = Watt = J/s

F = Farad = C/V

T = Tesla = N/A· m

H = Henry = T· m^2/A

Hz = Hertz = s^{-1}

rad = radian

nm = nanometer = 10^{-9}m

$c = 3 \times 10^8$ m/s

$\epsilon_0 = 8.85 \times 10^{-12}$ F/m

$\mu_0 = 4\pi \times 10^{-7}$ T· m/A

Refractive indices

Medium	n
Vacuum	1
Air	1.0003
Ice	1.31
Water	1.33
Glass (Crown)	1.52
Diamond	2.42

MATH

Circle: $c = 2\pi r$, $A = \pi r^2$

Sphere: $A = 4\pi r^2$, $V = \frac{4}{3}\pi r^3$

$i = \sqrt{-1}$

$\cos\theta = 1 - \theta^2/2! + \theta^4/4! - \ldots = \left(e^{i\theta} + e^{-i\theta}\right)/2$

$\sin\theta = \theta - \theta^3/3! + \theta^5/5! - \ldots = \left(e^{i\theta} - e^{-i\theta}\right)/2i$

$e^{i\theta} = \cos\theta + i\sin\theta$

$e^{\theta} = 1 + \theta + \frac{\theta^2}{2!} + \ldots$

$z = x + iy = \sqrt{x^2+y^2}e^{i\cdot atan\frac{y}{x}} = \begin{pmatrix} x & y \\ -y & x \end{pmatrix}$

$J_1(\beta) = 0$ at $\beta = 3.833, 7.014, 10.174, 13.324, \ldots$