OPTICS I : Homework #1

(Due: 2 weeks)

[2.1] How many 'yellow' lightwaves (λ=580 nm) will fit into a distance in space equal to the thickness of a piece of paper (7.62 mm)? How far will the same number of microwaves ($\nu=10^{10}$ Hz and $v=3 \times 10^8$ m/s) extend?

[2.16] Given the wavefunctions of $\Psi_1=4\cdot\sin2\pi(0.2x-3t)$ and $\Psi_2=4\cdot\sin(7x+3.5t)$, determine in each case the values of (a) frequency, (b) wavelength, (c) period, (d) amplitude, (e) phase velocity, and (f) direction of motion. Time is in seconds and x is in meters.

[2-22] Write the expression for the wavefunction of a harmonic wave of amplitude 10^3 V/m, period 2.2×10^{-15} s, and speed 3×10^8 m/s. The wave is propagating in the negative x-direction and has a value of 10^3 V/m at t=0 and x=0.

[2-25] Does the following function, in which A is a constant, $\Psi(y,t)=(y-v\cdot t)\cdot A$ represent a wave? Explain your reasoning.

[2-30] Create an expression for the profile of a harmonic wave traveling in the z-direction whose magnitude at $z=-\lambda/12$ is 0.866, at $z=+\lambda/6$ is 1/2, and $z=\lambda/4$ is 0.

[2-35] Consider a lightwave having a phase velocity of 3×10^8 m/s and a frequency of 6×10^{14} Hz. What is the shortest distance along the wave between any two points that have a phase difference of 30°? What phase shift occurs at a given point in 10^{-6} s, and how many waves have passed by in that time?

[2-41] De Broglie's hypothesis states that every particle has associated with it a wavelength given by Plank's constant (h=6.6×10^{-34} J·s) divided by the particle's momentum. Compare the wavelength of a 6.0-kg stone moving at a speed of 1.0 m/s with that of light.