Homework for Optical part 1 : Answers

1. A electro-magnetic wave is specified by the following function (in SI unit):

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Find (a) the direction along which the electric field oscillates, (b) the scalar value of the amplitude of the E-field, (c) the direction of the propagation of the wave, (d) the propagation number (or wave vector value) and wavelength, (e) the frequency and angular frequency, (f) the speed. (g) the irradiance *I.*

(a) The unit vector in the direction along which the electric field oscillates is .

(b)

(c) , so the unit vector in the direction of the propagation of the wave is .

(d) ,

(e) ,

(f)

(g)

2． Given 3 harmonic waves, , where φ are 0, π/3, 2/3π. Find the resultant wave which is a superposition of the three harmonic wave.

3. Given two waves:

 and  (Here , not the unit vector long x-direction)

Please find out the phase difference between the two waves and which one is leading.

Since , n is an integer. 



When n=0, E2 lags in phase by 

When n=1 or -1 (other integers would be same), E2 leads in phase by 

4. and are two E-M waves in vacuum and  where  is much smaller than . Show that where .

so that

6． ( Hecht’ 3.10) The time average of some function over an interval of time is given by:



if τ=2π/ω is the period of a harmonic function, show that:

and  when T=τ, and T>>τ.

When ,

When ,

6. 

7. Hecht’s book, problem 3.23

The energy of a single photon

So the number of photons emitted per second