PHY 201 : Assignment-3

All Problems carry equal weightage. Symbols have their usual meanings.

1. On a dielectric media with parameters ϵ, μ an electromangnetic wave is incident from left at an angle θ_I on its boundary at $x = 0$. Write down the conditions of electic and magnetic fields continuity. Obtain *Snell's law* of optics from these.

2. For the above question find out the expressions for magnetic field refectivity and transmitivity both for perpendicular component $B_\perp$ and the parallel component $B_{||}$.

3. Find out the condition for superposition of electromagnetic waves which give rise to (i) clockwise circular polarizability, (ii) anticlockwise circular polarizability , (iii) clockwise elliptical polarizability. Show that in a limiting case, linear polarizability can be obtained from the elliptical polarizability.

4. If two electromagnetic waves of same frequency but with a position dependent phase difference $\Delta\phi(x)$ betwen them are combined together, find out the conditions where the net intensity is highest and the lowest, respectively. What property of $\Delta\phi(x)$ decides the distance between the point where the intensity is maximum and the point where it is the next minimum ?

5. In the previous problem how does the answer shift if the waves have unequal frequencies ?

6. Two electromagentic waves' electric and magnetic field components can be added linearly, i.e. $\vec{E} = a\vec{E}_1 + b\vec{E}_2$ also satisfies the wave equation (similarly for $\vec{B} = a\vec{B}_1 + b\vec{B}_2$). Does the direction of propagation also get added linearly $\vec{k} = a\vec{k}_1 + b\vec{k}_2$ such that it correctly gives the dierction of propagation of the net electromagnetic wave expressed through $\vec{E}, \vec{B}$? Argue your answer through the Maxwell's equations.