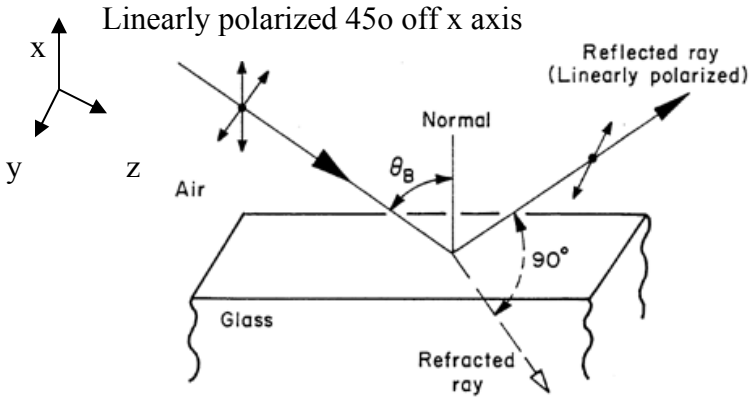
Homework 2: Electromagnetic Wave

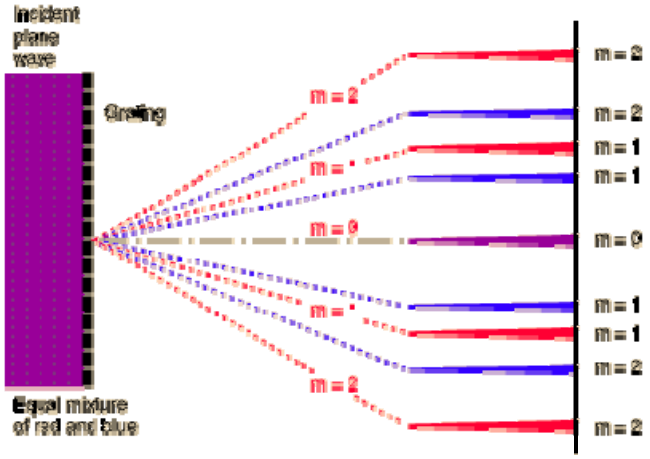
1. A converging lens 3.0 cm in diameter has a focal length f of 20cm. (a) what angular separation must two distant point objects have to satisfy Rayleigh's criterion? Assume λ *= 632nm. (b) what is the smallest spot size limited by diffraction if incident beam is Gaussian profile?*

2. For a case where $\mu_1 = \mu_2$ and parallel polarization, there is always a angle θ_b such that wave is totally transmitted and the reflection coefficient is zero $R_{ll} = 0$, *find* θ_b *and electric and magnetic field equation for the transmitted components and reflected components if incident wave is linearly polarized 45o off x axis*



3. For a case where $n_1 > n_2$ *and incident angle is greater than critical angle, find the electric and magnetic field equation for the transmitted components and reflected components when incident light is TM parallel polarized.*

4. A diffraction grating is the tool of choice for separating the colors in incident light. Here a white light is used, find two wavelengths (λ =632nm and λ =488nm) from the diffracted light. A diffraction grating frequnecy of 400line/mm is used, what will the displacement from the centerline for maximum intensity be for first three orders for each wavelength? What is the resolvance of such grating structure and what is the correponding wavelength resolution ($\Delta\lambda$) and Δy at the screen position (assume λ =632nm and distance from slit to screen is 100cm) use m=1?



5. Find the polarization (linear circular, elliptical) of the following fields (tip: covert to phaser form)

(a) $E = (j\hat{x} + \hat{y})e^{-jkz}$

(b) $E = [(1+j)\hat{x} + (1-j)\hat{z}]e^{-jkx}$

(c) $E = [(2+j)\hat{x} + (3-j)\hat{z}]e^{-jky}$

(d) $E = (j\hat{x} + j2\hat{y})e^{-jkz}$

7. Assuming an optical sensor made of silicone rubber patterned with diffraction grating is put under a tensile load. Assume two different orientation of diffraction gratings are used one 90^o off axial direction and the other 45^o. Plot Force versus displacement angle of 1st order if the corresponding Force versus grating period is given. (assume λ = 632nm and distance from slit to screen is 100cm)