PYL 115: APPLIED OPTICS

(Ist Semester, 2016-2017)

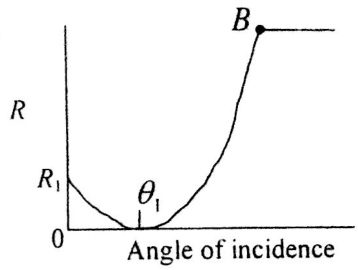
Minor-I

Duration: 1 hour **Max. Marks: 20**

Attempt ALL questions.

1. Given a plane wave: $\vec{E}(x,y,z,t) = (\hat{x} + A\,\hat{z})\,E_0 \exp[ik_0\{ct + (\sqrt{3}x + z)\}]$ where c is the speed of light in vacuum, obtain the refractive index of the medium in which the wave is propagating and obtain the value of the constant A. (3)

2. The reflectivity, R, of a plane-polarized wave travelling in a medium with index $n = \sqrt{3}$ and reflecting from an interface with air is shown in the figure. What is the polarization of the wave? What are the values of R_1 and θ_1 ? What are the values of reflectivity and the angle of incidence at point B shown in the figure? Give brief reasons for your answers. (5)



3. A crystal has the following dielectric permittivity (4)

$$\varepsilon = \varepsilon_0 \begin{pmatrix} 2.56 & 0 & 0 \\ 0 & 2.56 & 0 \\ 0 & 0 & 1.96 \end{pmatrix}$$

A linearly polarized optical wave that has a free-space wavelength $\lambda = 896\,\text{nm}$ is sent into the crystal. Find the wavelength of the wave in the crystal in each of the following cases.

i) The wave is polarized along $\hat{z}$ and propagates along $\hat{y}$ inside the crystal.
ii) The wave is polarized along $\hat{z}$ and propagates along $\hat{x}$ inside the crystal.
iii) The wave is polarized along $\hat{x}$ and propagates along $\hat{z}$ inside the crystal.
iv) The wave is polarized along $\hat{y}$ and propagates along $\hat{x}$ inside the crystal.

4. An unpolarized monochromatic beam of intensity I_0 is to be converted into a circularly polarized light. Suggest a way of doing this. What is the intensity of the circularly polarized beam? (4)

5. Two plane polarized beams are interfering on a plane screen (along x-y plane) and are producing a fringe pattern due to the phase difference $\delta(x,y)$ between them. The intensity of both beams is same; however, one beam is polarized at an angle θ with respect to the other. Obtain the visibility of the fringe pattern. (4)

$$r_s = \frac{E_{Sr}}{E_{Si}} = -\frac{\sin(\theta_i - \theta_t)}{\sin(\theta_i + \theta_t)} \qquad r_p = \frac{E_{Pr}}{E_{Pi}} = \frac{\tan(\theta_i - \theta_t)}{\tan(\theta_i + \theta_t)}$$