69

EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE – 2012/2013

SECOND SEMESTER (PROPER/REPEAT)

(August/September 2015)

PH 102 PHYSICAL OPTICS-I

Time: 01 hour.

Answer ALL Questions

---

1) When two monochromatic light beams of wavelength λ, intensities I_1 and I_2 and phase difference δ are interfered at any point in space as shown in figure 1, the resultant intensity distribution at point P is given by

$$I_P = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\delta .$$

Obtain the conditions for maximum and minimum intensities and show a schematic plot describing the variation of I_P against δ.

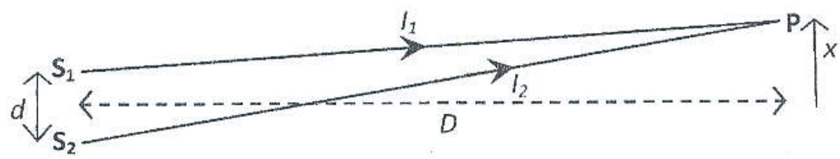

Figure 1

In the arrangement shown in figure 1, the phase difference between the two interfering beams is given by $\delta = \frac{2\pi}{\lambda}\left(\frac{xd}{D}\right) + (\alpha_1 - \alpha_2)$, where $(\alpha_1 - \alpha_2)$ is the initial phase difference.

a) Explain why interference fringes will not be visible when S_1 and S_2 are two independent monochromatic light sources; and how this problem is overcome in a Fresnel's biprism experimental arrangement to observe interference.

b) A parallel beam of monochromatic light of wavelength 5893Å incident upon a Fresnel bi-prism and straight parallel interfering fringes were observed in a screen which was placed 100 cm from the slit. When a lens inserted between the bi-prism and the screen, images of coherent sources were formed in two different positions with separation 4.05 mm and 2.90 mm. If the bi-prism is made of glass of refractive index 1.5 and is illuminated at a distance 25 cm from the slit, then calculate

i. the separation of the coherent sources S_1 and S_2;
ii. the fringe width; and
iii. the angle at the vertex of the prism.

70

2) Figure 2 shows two mutually coherent monochromatic light beams obtained by division o amplitude, and the phase difference between the two beams are given b $\delta = \frac{2\pi}{\lambda} 2d\cos\theta \pm \pi$, where "+" is when $\mu < \mu_1$ and "–" is when $\mu > \mu_1$.

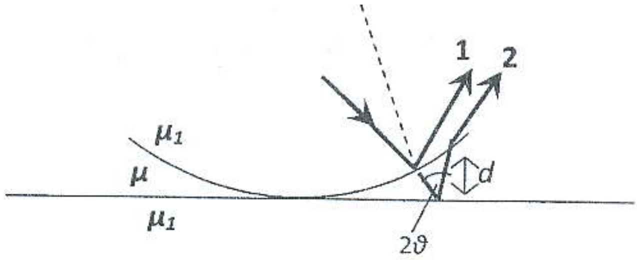

Figure 2

i. If r_m is the radius of m^{th} order dark fringe and R is the radius of curvature of the curved surface, then show that the height of the air film at m^{th} order is given by $d_m = \frac{r_m^2}{2R}$.

ii. Distinguish "fringes of equal thickness" from "fringes of equal inclination".

iii. If the condition for dark fringes is $\delta = (2m+1)\pi$, where m is an integer, then deduce that the height of the air film at m^{th} order is $d_m = \frac{m\lambda}{2}$.

iv. If radius of curvature $R = 26.1$ m and wavelength of the fringe observed is 568 nm then calculate the radius of 10^{th} order dark ring?