EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2010/2011

SECOND SEMESTER

(June 2013)

PH 102 PHYSICAL OPTICS I

Time: 01 hour.

Answer ALL Questions

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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.

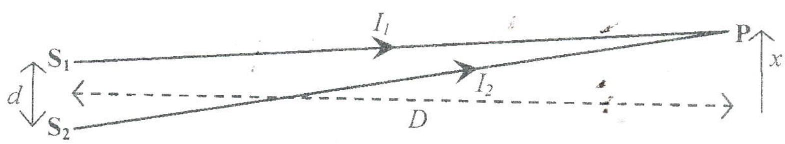

Figure 1

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 Young's Double Slit experimental arrangement to observe interference.

b) In a Young's Double Slit Experiment, two straight and parallel narrow slits are illuminated by a monochromatic light of wavelength 5900 Å. Fringes are observed on a screen distanced D=0.60 m from the double slit and fringe-width is measured to be of 0.12 mm. Find the separation between the double slits d. Take $\Delta = \frac{xd}{D}$, where x is the distance from the central fringe to any given fringe.

2. Figure 2 shows a part of a transparent wedge film of small inclination, which may be used to observe interference fringes. The phase difference between the two interfering beams are given by $\delta = \frac{2\pi}{\lambda} 2\mu d \cos\theta \pm \pi$, where "+" is when $\mu < \mu_1$ and "–" is when $\mu > \mu_1$.

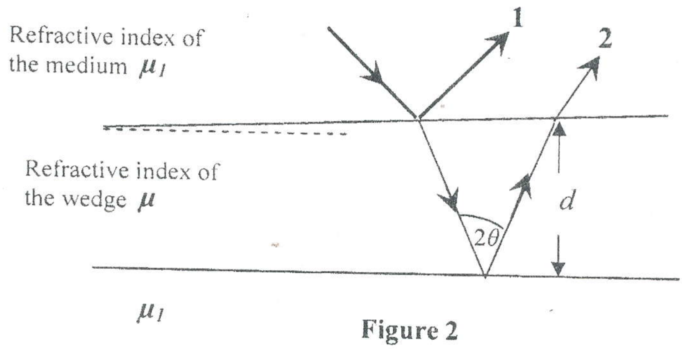

Figure 2

a) If the condition for bright fringe is $\delta = 2m\pi$, obtain expressions for m^{th} order bright fringes of *constant thickness* and *equal inclination*.

b) Fringes of *constant thickness* are formed with light of wavelength 6300 Å incident normally on a thin wedge shaped film of refractive index 1.50 kept in air medium. There are ten bright and nine dark fringes over a length of the film. How much does the film thickness change over this length?

c) Fringes of *equal inclination* are formed with a plane parallel glass plate of refractive index 1.50 and thickness 2 mm kept in air medium. If a monochromatic light source of wavelength 6000 Å is used, how many bright fringes are formed in the entire range from normal incidence to grazing incidence?