EASTERN UNIVERSITY, SRI LANKA
SECOND EXAMINATION IN SCIENCE - 2009/2010
SECOND SEMESTER (PROPER/REPEAT)
(April 2012)
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 P in space, the resultant intensity distribution at point P is given by

$$I_P = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\delta . \qquad (1)$$

(i) Assuming the intensity through each slit is I, show that for Young's double slit experiment, equation (1) may be expressed as $I_P = 4I\cos^2\left(\frac{\pi x d}{\lambda D}\right)$; where d is the slit separation, D is the distance from the slit to observation screen, and x is the distance from the central fringe to any given fringe.

(ii) Hence, obtain the conditions for bright and dark fringes and show that the fringe width is same and given by $\frac{D\lambda}{d}$.

(iii) 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 measured to have fringe width 0.12 mm. Find,

a) the separation between the double slits d;

b) the distance between the 2nd and 9th order bright fringes.

2. Figure 1 shows a part of a transparent wedge film of small inclination, which may be used to obtain two mutually coherent monochromatic light beams 1 and 2 by the method of *division of amplitude,* in order to observe interference fringes. The phase difference between the two 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 $\mu > \mu_1$.

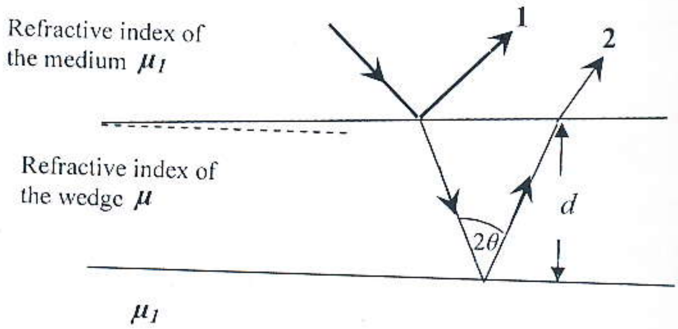

Figure 1

(i) Distinguish 'fringes of constant thickness' from 'fringes of equal inclination' observed in interference by division of amplitude, and write the equations governing the condition $\delta = 2\pi m$ for m^{th} order bright for the two types of fringes.

(ii) A film of oil (optically denser than glass) is place between a convex glass lens and a flat glass plate in a Newton's Rings arrangement.

a) Obtain an expression for n^{th} order bright fringe of constant thickness.

b) The radius of curvature of surface of the lens that is in contact with the liquid is 1 m. If the diameter of the 7^{th} order bright fringe is measured to be 3.25 mm using light of wavelength 6000 Å, then find the refractive index of the liquid.