EASTERN UNIVERSITY, SRI LANKA

FIRST EXAMINATION IN SCIENCE - 2008/2009

SECOND SEMESTER (PROPER/REPEAT)

(October/November 2010)

PH 102 PHYSICAL OPTICS I

Time: 01 hour.

Answer ALL Questions

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1. When two monochromatic and coherent light beams having intensities I_1 and I_2 are superimposed, the intensity variation across the observed fringe pattern is given by:

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

Where δ is the phase difference between the two beams at the observation plane.

(a) Give a quantitative plot for the variation of intensity against δ.

(b) Show that in a Young's double slit experiment (assume that the two slits are identical):

$$I = 4I_o\cos^2\left(\frac{\pi x d}{\lambda D}\right)$$

where the symbols have their usual meaning and d is the slit separation, D is the distance between the slits and the screen and x is the distance to any given fringe from the central fringe.

(c) In a double slit experiment $d = 5\ mm$ and $D = 1\ m$. Two interference patterns can be seen on the screen. One due to light of wavelength 4800 Å and the other due to light of wavelength 6000 Å. What is the separation on the screen between the third order bright fringes of the two patterns?

2. Newton's rings are formed due to the interference by division of amplitude. Show that the phase difference δ between two interfering beams from a thin transparent film of varying thickness d and refractive index μ is given by:

$$\delta = \frac{2\pi}{\lambda} 2\mu d \cos\theta \pm \pi$$

Sketch a diagram for the experimental arrangement to observe Newton's rings. Show that in a Newton's rings experiment, the diameter of the n^{th} order dark ring is given by:

$$D_n^2 = \frac{4n\lambda R}{\mu}$$

Here the symbols have their usual meanings.

A Newton's ring arrangement is used with a source emitting two wavelengths $\lambda_1 = 6 \times 10^{-7} m$ and $\lambda_2 = 4.8 \times 10^{-7} m$. It is found that n^{th} dark ring of λ_1 coincides with $(n+1)^{th}$ dark ring of λ_2. If the radius of curvature of the lens is 60 cm then find the common diameter of these two rings.