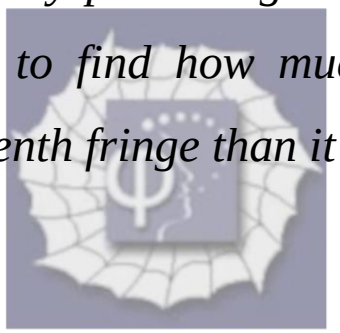
640.

Problem 45.35 (RHK)

Two pieces of plate glass are held together in such a way that the air space between them forms a very thin wedge. Light of wavelength 480 nm *strikes the upper surface perpendicularly and is reflected from the lower surface of the top glass and the upper surface of the bottom glass, thereby producing a series of interference fringes. We have to find how much thicker is the air wedge at the sixteenth fringe than it is at the sixth fringe.*



Solution:

We note that as the refractive index of air is less than that of the glass, there will be no change in phase on reflection from the lower surface of the top glass. However, there will be an additional change in phase on reflection of the ray that is reflected from the top surface of the bottom glass as the ray is incident from air whose refractive index is less than that of glass. As there is a phase change of $2\pi \times 2d/\lambda$, where d is the thickness of the air wedge, the condition for fringe formation is

$$\frac{4\pi d}{\lambda} = (2m+1)\pi,\ \text{m} = 0,1,2,3..$$

Therefore, the thickness of the air wedge at the sixth fringe will be

$$d_6 = \frac{11\lambda}{4},$$

And the thickness of the air wedge at the sixteenth fringe will be

$$d_{16} = \frac{31\lambda}{4}.$$

$$\therefore\ d_{16} - d_6 = \frac{20\lambda}{4}.$$

As λ=480 nm, we find

$$d_{16} - d_6 = \frac{20 \times 480}{4}\ \text{nm}$$

$$= 2400\ \text{nm} = 2.4\ \mu\text{m}.$$