643.

Problem 45.41 (RHK)

Light of wavelength 630 nm *is incident normally on a thin wedge-shaped film with index of refraction* 1.50. *There are ten bright and nine dark fringes over the length of the film. We have to find the amount through which the film thickness changes over this length*.

Solution:

We assume that the wedge-shaped film with index of refraction 1.50 is surrounded by air. The light of wavelength 630 nm is incident normally on the wedge. Let the thickness of the wedge where a fringe is formed be *d* nm. The condition for constructive interference of waves reflected from the top of the film and the bottom of the film will be

$$\frac{2d \times 2\pi}{\lambda_n} = (2m+1)\pi, m = 0,1,2,3....$$

The wavelength of light inside the film changes because the refractive index of the film is 1.50. We have

$$\lambda_n = \frac{630}{1.5}\ \text{nm} = 420\ \text{nm}.$$

The first fringe corresponds to $m = 0$. The thickness of the film at the position of the first fringe will therefore be

$$d_1 = \frac{420}{4}\ \text{nm} = 105\ \text{nm}.$$

The tenth fringe corresponds to $m = 9$. The thickness of the film at the position of the first fringe will therefore be

$$d_{10} = \frac{19 \times 420}{4}\ \text{nm} = 1{,}995\ \text{nm}.$$

Therefore,

$$d_{10} - d_1 = (1{,}995 - 105)\ \text{nm} = 1{,}890\ \text{nm}$$
$$= 1.89\ \mu\text{m}.$$