Case II :- Minimum Intensity :-

For the minimum intensity we know that
path difference = $(2n+1)\frac{\lambda}{2}$

$$2\mu t\cos r = (2n+1)\frac{\lambda}{2}$$

- **Colours in thin film :-**

When a thin film is elluminated by the mono-chromatic light and seen due to reflected light then it will appear bright if $2\mu t\cos r = (2n+1)\frac{\lambda}{2}$ and dark if $2\mu t\cos r = n\lambda$

But the film is elluminatid by the white light then the films shows different colour which is understood (discussed) below.

When the eye looking the film received the wave of light reflected from the upper and lower surface of the film. But the path difference depends upon the thicknen 't' of the film and the inclination 'r' of the incident rays. We know that the white light consists of continuous range of wavelengths. Hence for a particular point of the film and for a particular value to t and r the waves of only certain colours satisfy the condition of maximum. Therefore only those colours will be present in the reflected system with the maximum intensity. And the other neighbouring colours will be present with less intensity which satisfy the condition of minimum intensity and absent from the reflected light.

As a result such point of the film

will appear colour.

Therefore to view the whole film the reflected rays are focussed by the lens and hence the thin films appears coloured and this is the physical significance of colours in thin film..

The above phenomenon is opposite when the film is seen due to transmitted ray, hence the colours in the reflected light will be complementary to the colours when it is eliminated by white light. Colours are not observed in the case of a thick film, when the film of a large thickness is elluminated by white light then there is no interference will be observed that is in case of thick film, the condition of Constructive Interference at a given point is satisfied by a large number of colours and at the same point the condition is distructive interference is also satisfied. And hence as a result the intensity at a given point is almost equal to zero (0), That is why in case of a thick film elluminated by white light, then the colours are not observed in the reflected light.

Numerical

① The light of wavelength 5893 Å is reflected from a soap film of refractive index 1.42. Then calculated the thickness of the film in the case of black and bright when it is eliminated by reflected light.

Soln. Given:-

$\lambda = 5893$ Å

$\mu = 1.42$

Case-I For Maximum Intensity:-

$$2\mu t\cos r = (2n+1)\frac{\lambda}{2} \quad \text{——— (1)}$$

Here, $\mu = 1.42$

Angle of inclination is very small

$\therefore r = 0^\circ$

$n = 1$

$$2\mu t = \frac{3\lambda}{2}$$

$$t = \frac{3\lambda}{4\mu}$$

or,

$$t = \frac{3 \times 5893}{4 \times 1.42} = \frac{17679}{5.63}$$

$\therefore t = 3140.14$ Å Answer

Case II. <u>For Minimum Intensity</u> :-

$$2\mu t\cos r = n\lambda \quad \text{— (2)}$$

Here,

$\mu = 1.42$

Angle of inclination is very small

$\therefore r = 0^\circ$

$n = 1$

$$2\mu t = \lambda$$

$$t = \frac{\lambda}{2\mu} = \frac{5893}{2 \times 1.42} = \frac{5893}{2.84}$$

$\therefore t = 2075$ Å Answer