Section - 3

Ans 1 (a and b)

Acceptance Angle and Numerical Aperture

$$\frac{\sin i}{\sin r} = \frac{n_1}{n_0}$$

$$\sin i = \left(\frac{n_1}{n_0}\right) \sin r \quad \text{--- (1)}$$

from ΔABB

$$\angle r = (90^\circ - \theta)$$

~~$\sin r$~~

$$\sin r = \sin(90 - \theta)$$

$$\sin r = \cos\theta$$

from eqn (1) putting value of $\sin r$

$$\sin i = \left(\frac{n_1}{n_0}\right) \cos\theta \quad \text{--- (2)}$$

from maximum acceptance angle

$$\sin i = \left(\frac{n_1}{n_0}\right) \cos\theta_c$$

$$\sin i^\circ_{max} = \left(\frac{n_1}{n_0}\right) \sqrt{1 - \sin^2\theta_c}$$

$$\sin\theta_c = \frac{n_2}{n_1} \quad \left\{ \because \theta_c = \sin^{-1}\left(\frac{n_1}{n_2}\right) \right\}$$

$$\sin i = \frac{n_1}{n_0} \sqrt{1 - \left(\frac{n_2}{n_1}\right)^2}$$

$$= \frac{n_1}{n_0} \sqrt{\frac{n_1^2 - n_2^2}{n_1^2}}$$

$$\boxed{\sin i_{max} = \sqrt{n_1^2 - n_2^2}}$$

This expression is called Numerical appardture.

$$i_{max} = \sin^{-1}\sqrt{n_1^2 - n_2^2}$$

if considerd $i_{max} = i_0$

$$\boxed{i_0 = \sin^{-1}\sqrt{n_1^2 - n_2^2}}$$

This expression is called acceptence angle.