CHAPTER-9

RAY OPTICS AND OPTICAL INSTRUMENTS

FORMULAE :

(1) Mirror equation :

There is following simple relation between the distance U of the object from the mirror, the distance V of the image from the mirror and focal length f of the mirror :

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$

(2) Linear magnification:

The linear magnification of a spherical mirror is the ratio height of the image (h_2) formed by the mirror to the height of object (h_1) i.e.

$$\text{Leaner magnification (m)} = \frac{\text{Height of image}}{\text{Height of object}}$$

$$= \frac{h_2}{h_1}$$

(3) Absolute refractive index :

(a) If the incident ray is traveling in vacuum (and to a good approximation in air) and is then refracted in a medium, then ratio $\frac{\text{Sini}}{\text{Sinr}}$ is called absolute refractive index of the medium

i.e.

$$\mu = \frac{\text{Sini}}{\text{Sinr}} \text{ …… incident ray in vacuum / air}$$

(b) The absolute refractive index. = μ

$$\therefore \mu = \frac{\text{Velocity of light in vacuum (c)}}{\text{Velocity of light in medium}}$$

lens formula : $\frac{1}{f} = \frac{1}{v} - \frac{1}{a}$

(4) Refraction through curved surface :

$$\frac{\mu}{v} - \frac{1}{u} = (\mu - 1)\frac{1}{R}$$

Where, μ = refractive index of 2^{nd} medium w.r.t 1^{st} medium.

(5) Len's maker's formula :

$$\frac{1}{v} - \frac{1}{u} = (\mu - 1)\left(\frac{1}{R_1} - \frac{1}{R_2}\right)$$

(6) In a Prism for minimum deviation

$$\mu = \frac{\sin\left(\frac{A + \delta_n}{2}\right)}{\sin\frac{A}{2}}$$

Where, μ = refractive index of prism

(7) Optical instruments :

(i) Simple microscope :

$$\mathbf{m} = \left(1 + \frac{D}{f}\right)$$ where, m = magnification

(ii) Compound microscope :

$$\mathbf{m} = -\frac{v_0}{u_0}\left(1 + \frac{D}{f_e}\right)$$

Where,

for objective lens v_0 = image distance

u_0 = object distance

f_e = focal length of eye piece

(iii) Telescope (Refracting type) :

When $L = f_o + f_e$

$$m = \frac{f_o}{f_e}$$

When $L < f_o + f_e$

$$m = \frac{f_o}{f_e}\left(1 + \frac{D}{f_e}\right)$$