**9-RAY OPTICS AND OPTICAL INSTRUMENT**

**1.FORMATION OF IMAGE BY SPHERICAL MIRRORS**

1. For any spherical mirror,  2. Mirror formula,  3. Magnification,  4. Magnification *m* is –ve for real images and +ve for virtual images. 5. *f* and *R* are –ve for a concave mirror and +ve for a convex mirror. 6. For a real object *u* is –ve, *v* is –ve for real image and +ve for virtual image. 7. Do not give any sign to unknown quantity. The sign will automatically appear in the final result.

**2. Refraction of Light (ii) Lateral shift and (iii) Real and Apparent Depths**

1. Refractive index = or  2.  3. Snell’s law,  or  4.  5.  or  6. Lateral shift of a ray through a rectangular slab,  

7.  Apparent depth =  8. Apparent shift = *t*  9. Total apparent shift for compound media 

**3. Total Internal Reflection**

1. Critical angle, *ic* = Angle of incidence in denser medium for which angle of refraction is 900 in rarer medium. 2. Refractive index of denser medium,  3. Total internal refraction occurs when *i > ic*

**4. Refraction through Spherical Surfaces**

1. For refraction from rarer to denser medium,  2. For refraction from denser to rarer medium.  3. Power of a surface, (for air) 4. First principal focal length  5. Second principal focal length  

**5. Len’s Maker’s formula**

1. For the lens of material of refractive index μ2 placed in a medium of refractive index μ1 

2. When the lens is placed in air,  and μ2 = μ  3. *f* and *R* are positive for convex surfaces and negative for concave surfaces.

**6. Thin Lens Formula and Linear Magnification**

1. Focal length of any lens is given by the thin lens formula  2. Magnification,  3. In Cartesian sign convention, *u* is taken negative 4. In case of convex lens, *v* is positive for real image and negative for virtual image and *f* is positive. 5. In case of concave lens *u*, *v* and *f* are all negative. 6. Magnification *m* is positive for virtual image and negative for real image.

**7. (i) Power of Lenses (ii) Combination of Lenses**

1. Power of a lens,  2.  3. For a combination of lenses  4. For two lenses in contact, equivalent focal length *F* is given by  or Power  For *n* lenses in contact, 

5. The equivalent focal length *F* two lenses separated by distance *d* is give by  or Power, 

**8. Image formation by a combination of a lens and a mirror**

We first find the position of the image formed by the lens by using thin lens formula. Taking this image as real (or virtual) object for the mirror, we use mirror formula to locate the position of the final image formed by the combination.

**9. Refraction and Dispersion of Light through a prism**

1. For refraction through a prism. and *r +r’=A* 2. In the condition of minimum deviation,  3. Deviation produced by a prism of small angle.  4. Angular dispersion =  5. Dispersive power,  6. Mean deviation,  7. Mean refractive index, 

**10. Defects of Vision**

1. Correction of myopia or short sightedness. A concave lens of focal length *f* equal to the distance *x* of the far point from the defective eye is used. *f = - x* and  2. Correction of hypermetropia or long sightedness. A convex lens of focal length *f* is used, where  Here *x* = distance of the near point from the defective eye and D = the least distance of distinct vision.

**11. Simple Microscope**

1. When the final image is formed at the least distance of distinct vision, the magnifying power is  2. When the final image is formed at infinity, the magnifying power is 

**12. Compound Microscope**

1. Magnifying power,  2. When the final image is formed at the least distance of distinct vision,  3. When the final image is formed at infinity 

**13. Telescopes**

1. *Astronomical telescope* (i) In normal adjustment  Distance between objective and eyepiece = *fo + fe* (ii) When the final image is formed at the least distance of distinct vision,  Distance between objective and eyepiece 

2. *Terrestrial telescope*. (i) In normal adjustment, 

Distance between objective and eyepiece  where *f* = focal length of the erecting lens*.*  3. *Galileo’s telescope*. In normal adjustment,  Distance between objective and eyepiece  4. *Reflecting telescope*.  Where *f­0* = focal length of concave mirror. *fe* = focal length of eyepiece.