Matrix Method in Geometrical Optics (Problem set 3)

Sanat Karmakar

1. Consider a thick lens whose magnitudes of radii of curvature of the first and second surfaces are 45 cm and 30 cm respectively. Thickness of the lens is 5 cm and refractive index of the material of lens is 1.5. Determine the system matrix and positions of the unit planes. Determine the image point of an object at a distance of 90 cm from the first surface.

2. Two thin convex lenses of focal lengths 30 cm and 40 cm are placed 20 cm apart in air. If an object is located at a distance 48 cm from the first lens. Find the positions of the image by using matrix method.

3. An object of height 1.5 cm is placed at a distance 40 cm in front of a convex lens of focal length 20 cm. Behind the convex lens a concave lens of focal length -10 cm is placed at a distance of 15 cm from the convex lens. Determine the system matrix. Find the size, position and nature of the image.

4. A glass lens with radii $r_1 = +3.0$ cm and $r_2 + 3.0$ cm has an refractive index of 1.60 and a thickness of an 3 cm. IT is placed in the end of tank so that air is contact with face r_1, and a transparent oil of refractive index 1.30 is in contact with face r_2. Find

   - the primary and secondary focal lengths
   - the power of the system of lens.
   - calculate the positions of focal points, principal points and nodal points.

5. An equiconvex lens with radii of 4 cm and index $n_1 = 1.5$ is located 2 cm in front of an equiconcave lens of radii 6 cm and index $n_2 = 1.6$. The lenses are to be considered as thin. The surrounding media have indices $n = 1.00$, $n' = 1.33$ and n'' $= 1.00$. Find

   - the power
   - the focal lengths
   - the focal points and principal points of the system