10^{Th} Class

➢ SPHERICAL LENSES:

1. Definition:

Spherical lenses are transparent optical devices with curved surfaces that refract light, leading to the formation of images.

2. Types of Spherical Lenses:

- **Convex Lens:**

Thicker at the center and thinner at the edges.
Converges light rays to a focal point.
Forms real or virtual images depending on the object's position relative to the focal point.

- **Concave Lens:**

Thinner at the center and thicker at the edges.
Diverges light rays, spreading them out.
Forms only virtual images that are always diminished and upright.

3. Principal Axes and Focal Points:

Principal axis: Imaginary line passing through the center of the lens perpendicular to its surfaces.
Focal point: Point on the principal axis where parallel light rays converge (for convex lens) or appear to diverge (for concave lens) after refraction.

4. Focal Length:

Distance between the optical center of the lens and its focal point.
Determines the strength of the lens. Shorter focal lengths indicate stronger lenses.

5. Lens Formula:

$1/f = 1/v - 1/u$

f: Focal length of the lens.

v: Image distance (distance of the image from the lens).

u: Object distance (distance of the object from the lens).

6. Sign Conventions:

Object distance (u) is negative for real objects placed on the same side as the incident light.

Image distance (v) is negative for real images formed on the opposite side of the lens from the incident light.
Focal length (f) is positive for convex lenses and negative for concave lenses.

7. Image Formation:

- **Convex Lens:**

Real images are formed on the opposite side of the lens from the object.
Virtual images are formed on the same side as the object.

- **Concave Lens:**

Only virtual images are formed on the same side as the object.

8. Lens Power:

The ability of a lens to bend light rays, measured in diopters (D).
$P=1/f$, where P is the power of the lens and f is the focal length in meters.

9. Applications:

Convex Lenses: Used in magnifying glasses, cameras, projectors, and corrective lenses for farsightedness.

Concave Lenses: Used in correcting nearsightedness and in devices such as eyeglasses for reading.

10. Lens Aberrations:

Spherical aberration, chromatic aberration, and coma are common aberrations that affect the quality of images produced by lenses.