Unit -5

Nature of light

Light is in the form of an energy and is a transverse, electromagnetic wave that can be seen by the typical human. The wave nature of light was first illustrated through experiments on diffraction and interference. Like all electromagnetic waves, light can travel through a vacuum. The transverse nature of light can be demonstrated through polarization.

Light is produced by one of two methods…

- **Incandescence** is the emission of light from "hot" matter ($T \gtrsim 800$ K).
- **Luminescence** is the emission of light when excited electrons fall to lower energy levels (in matter that may or may not be "hot").

speed.

- The speed of light in a vacuum is a universal constant in all reference frames.
- The speed of light in a vacuum is fixed at 299,792,458 m/s or 3×10^8 m/ s by the current definition of the meter.
- The speed of light in a medium is always slower the speed of light in a vacuum.
- The speed of light depends upon the medium through which it travels.The speed of anything with mass is always less than the speed of light in a vacuum.

other characteristics

The amplitude of a light wave is related to its intensity.

- **Intensity** is the absolute measure of a light wave's power density.
- **Brightness** is the relative intensity as perceived by the average human eye.

The frequency of a light wave is related to its color.

- Color is such a complex topic that it has its own section in this book.
- **Monochromatic** light is described by only one frequency.
  - Laser light is effectively monochromatic.
  - There are six simple, named colors in English (and many other languages) each associated with a band of monochromatic light. In order of increasing frequency they are **red, orange, yellow, green, blue, and violet.**
  - Light is sometimes also known as **visible light** to contrast it from "ultraviolet light" and "infrared light"
  - Other forms of electromagnetic radiation that are not visible to humans are sometimes also known informally as "light"
- **Polychromatic** light is described by many different frequencies.
  - Nearly every light source is polychromatic.

- White light is polychromatic.

Reflection of Light : There are some surfaces which have ability to send the light back in the same medium when light strikes it. This phenomena of sending the light back in the same medium by a surface is called reflection of light.

Laws of reflection

(i) The incident ray, the reflected ray and the normal at the point of incidence, all lie in a same plane.

(ii) The angle of incidence is always equal to the angle of reflection, $\angle i = \angle r$.

Image : When light rays meet or appear to meet after reflection from a mirror,then it is called an image. **Real Image :** It is a kind of image which is formed by actual intersection of light rays after reflection. **Virtual Image :** It is a kind of image which is formed by producing the reflected rays backward after reflection.

Plane Mirror : Plane mirror is a piece of glass whose one side is polished by using silver paint, which is covered by a coating of red paint to protect the silver layer.**. Spherical Mirrors :** It is part of hollow glass sphere whose one surface is polished.

There are two types of spherical mirror.

(i) Concave Mirror : It is a spherical mirror whose outer surface is polished and inner or concave side is reflecting surface.

(ii) Convex Mirror : It is a spherical mirror whose inner is polished and outer side or convex side is the reflecting surface.

Uses of Concave Mirror :

(i) It is used as a shaving mirror because when it is placed close to the face, it forms a large image.

(ii) It is used in solar heating devices like solar cooker, because it converges Sun’s rays over a small area to produce high temperature.

(iii) It is used for security checking purposes.

Uses of Convex Mirror :

(i) It is used as rear view mirror in automobiles because it gives erect image as well as diminished due to which Pt has wider field of view.

(ii) It is also used in street lights.

Mirror Formula :

It is a relation between distance of object, distance ofimage from the pole ofthe mirror and it's focal length, i.e., relation between 'u', 'v and It is given by

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

Refraction of Light : The bending of ray of light when it passes from one medium to another is called refraction of light.

Laws of Refraction :

(i) The incident ray, the refracted ray and the normal at the point of incidence all lie in the same plane.

(ii) When a ray of light undergoes refraction then the ratio of sine of angle of incidence to the sine of angle of refraction is constant.

The Refractive Index : The refractive index of medium 2 with respect to medium is given by the ratio of the speed of light in medium 1 and the speed of light in medium 2. This is usually represented by the symbol n_{21}. This can be expressed in an equation form as

$$n_{21}=\frac{\text{Speed of light in medium 1}}{\text{Speed of light in medium 2}}=\frac{v_1}{v_2}$$

THE OVERHEAD PROJECTOR

It is a device for projecting matter written (or drawn) on a transparent plastic sheet (25x20cm) on to a screen. It uses a lamp, lens and mirror arrangement. The versatility of the overhead projector has made it a powerful teaching tool and it has largely replaced the blackboard in the classrooms of affluent countries. It has several advantages over the blackboard:

i) The surface area is limitless.

ii) Material (including illustrations) can be prepared well in advance.

iii) The teacher faces the class all the time and eye-to-eye contact is not lost.

iv) The prepared transparencies can be preserved for future use.

The overhead projector also has several advantages over slides:

i) There is no need to darken the room (the students may stay awake!!)

ii) Progressive disclosure is very easy.

iii) The services of a projectionist are not required.

iv) Material can be prepared at short notice by the speaker himself.

v) The material on the stage of the overhead projector can be manipulated, added to, or altered in a way that is not possible with slides.

A little effort and imagination greatly improve the effectiveness of the overhead projector. A few hints and suggestions are given below:

1) The projector-screen arrangement has to be such that every student in the class can see every part of the projected image with ease. The screen may be placed at a higher level than the speaker (directly behind him) or in one corner of the room with the projector diagonally in front of it

2) Ensure that the smallest letter on the screen can be read comfortably by the persons in the last rows. Each letter or character on the transparency should be

atleast 8-10mm. high. There should be no more than six words in each line and no more than eight lines in each transparency. Your normal handwriting is just not enough. The use of a template is strongly recommended.

3) It is best not to project the entire transparency at the very beginning. Optimal 'progressive disclosure' of information achieves the same objective as the sequential presentation of information on the blackboard.

4) A hexagonal pencil, a slide with an arrow drawn on it and plastic or cardboard arrows all make good pointers. It is important that the pointer does not roll off the stage of the projector. The pointer must be laid flat on the transparency and not waved around

EPIDIASCOPE

The **opaque projector**, **epidiascope**, **epidiascope** or **episcope** is a device which displays opaque materials by shining a bright lamp onto the object from above. A system of mirrors, prisms and/or imaging lenses is used to focus an image of the material onto a viewing screen. Because they must project the reflected light, opaque projectors require brighter bulbs and larger lenses than overhead projectors. Care must be taken that the materials are not damaged by the heat generated by the light source. Opaque projectors are not as common as the overhead projector.

Opaque projectors are typically used to project images of book pages, drawings, mineral specimens, leaves, etc. They have been produced and marketed as artists' enlargement tools to allow images to be transferred to surfaces such as prepared canvas, or for lectures and discourses.

Small Episcope for home use

The light source in early opaque projectors was often limelight. Incandescent light bulbs and halogen lamps are most commonly used today.

In the early and middle parts of the 20th century, low-cost opaque projectors were produced and marketed as toys for children.

In educational settings, the specific role of the opaque projector has been superseded first by the overhead projector and later the document camera, a lighted table with a fixed video camera above it. The image from the camera is displayed using a separate projector. The document camera is also called a desktop presenter unit or opaque projector