Optics

(Lec-9)

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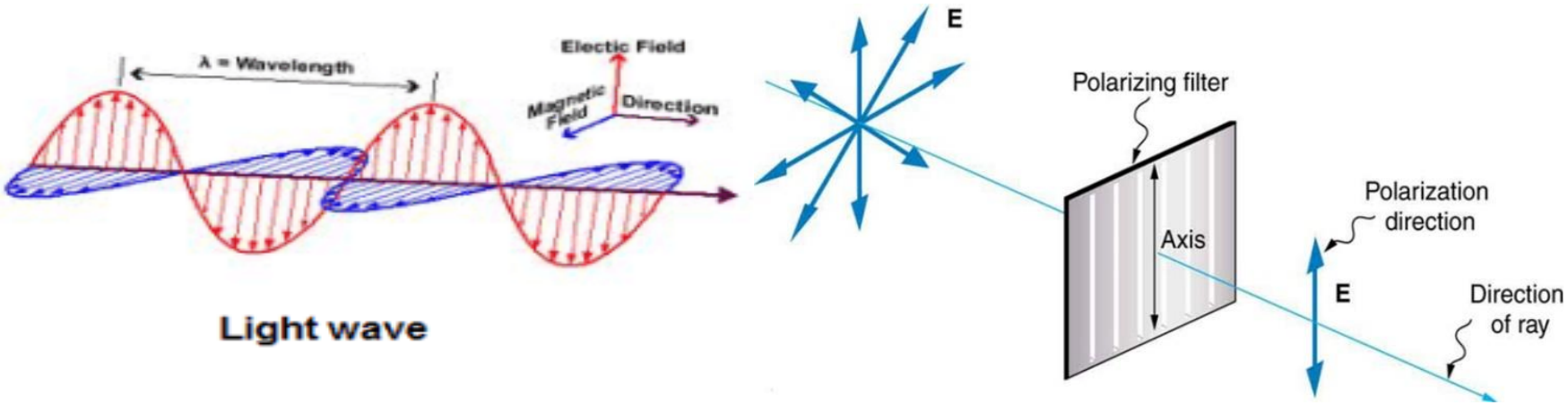
OUTLINES

- Polarization
- Classification of Polarization
- The optical processes by which linearly polarized light can be produced

Polarization

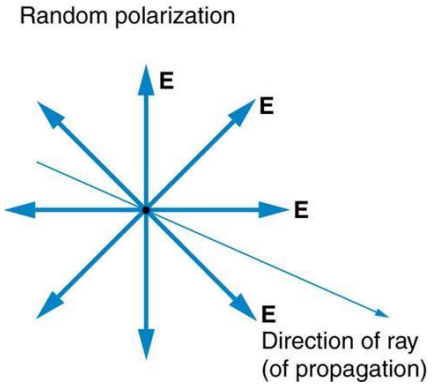
The process by which light waves vibrating in different planes can be made to vibrate in a particular plane is called polarization of light. Sound waves in a gas or liquid do not exhibit polarization, since the oscillation is always in the direction the wave travels.

In an electromagnetic wave, both the electric field and magnetic field are oscillating but in different directions.

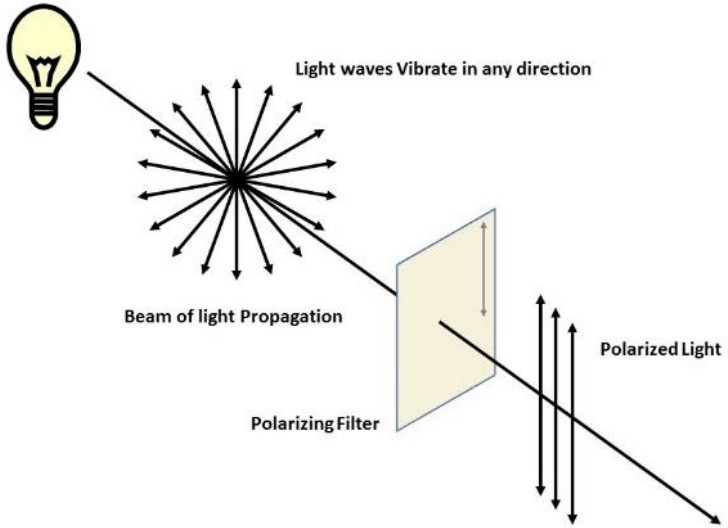


Some terms relating to polarization

- **Unpolarized light:** Ordinary light waves whose vibrations normal to the direction of propagation, spread all around the source with equal amplitude is called unpolarized light. The figure given below shows the unpolarized light.

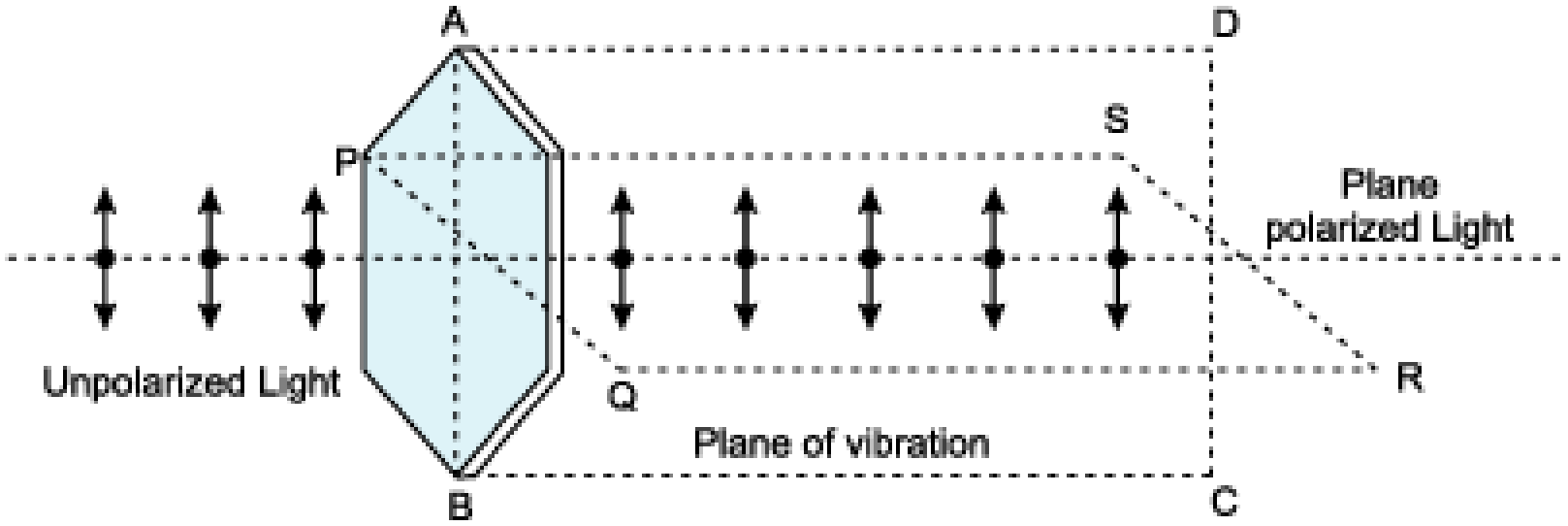


- **Polarized light:** The transverse light waves vibrating on a particular plane or parallel to it is called polarized light.



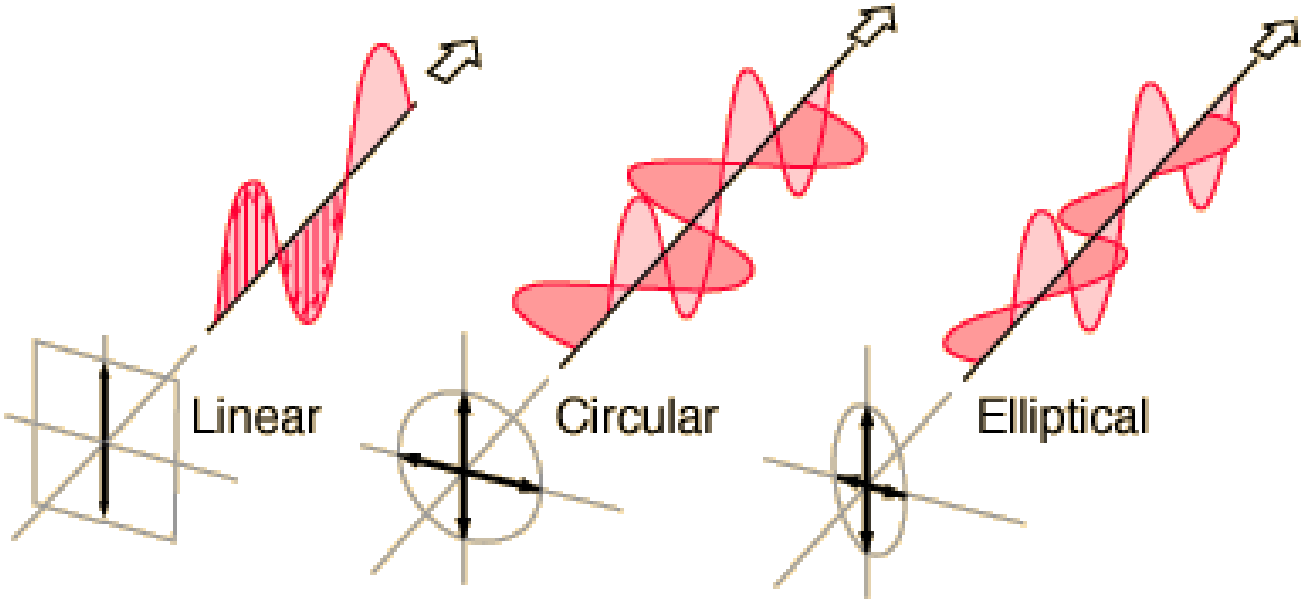
❖ **Plane of vibration:** The plane in which the particles of the light waves vibrate is called the plane of vibration. The below figure shows the plane of vibration. ABCD is the plane of vibration.

❖**Plane of polarization:** The plane which exists normal to the plane of vibration is called the plane of polarization. In the figure PQRS is the plane of polarization.



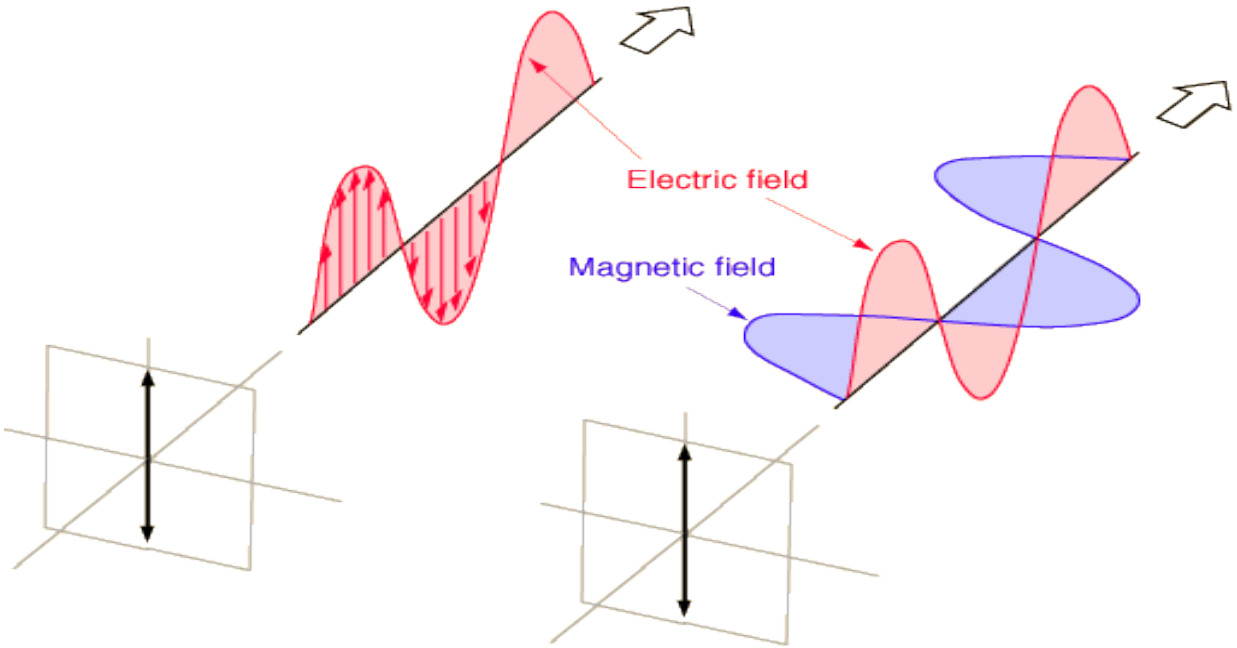
Classification of Polarization

Light in the form of a plane wave in space is said to be linearly polarized. Light is a transverse electromagnetic wave, but natural light is generally unpolarized, all planes of propagation being equally probable. If light is composed of two plane waves of equal amplitude by differing in phase by 90°, then the light is said to be circularly polarized. If two plane waves of differing amplitude are related in phase by 90°, or if the relative phase is other than 90° then the light is said to be elliptically polarized.



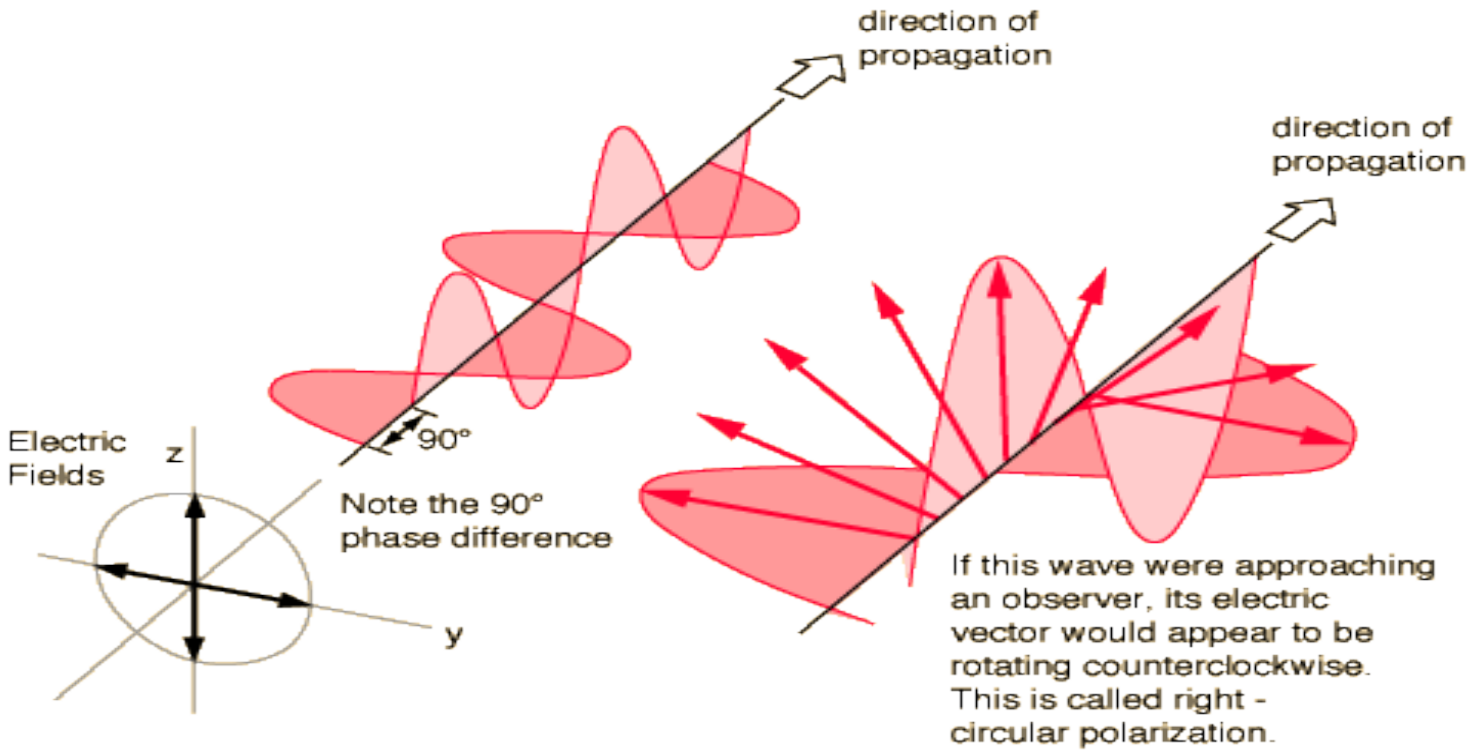
Linear Polarization

A plane electromagnetic wave is said to be linearly polarized. The transverse electric field wave is accompanied by a magnetic field wave as illustrated.



Circular Polarization

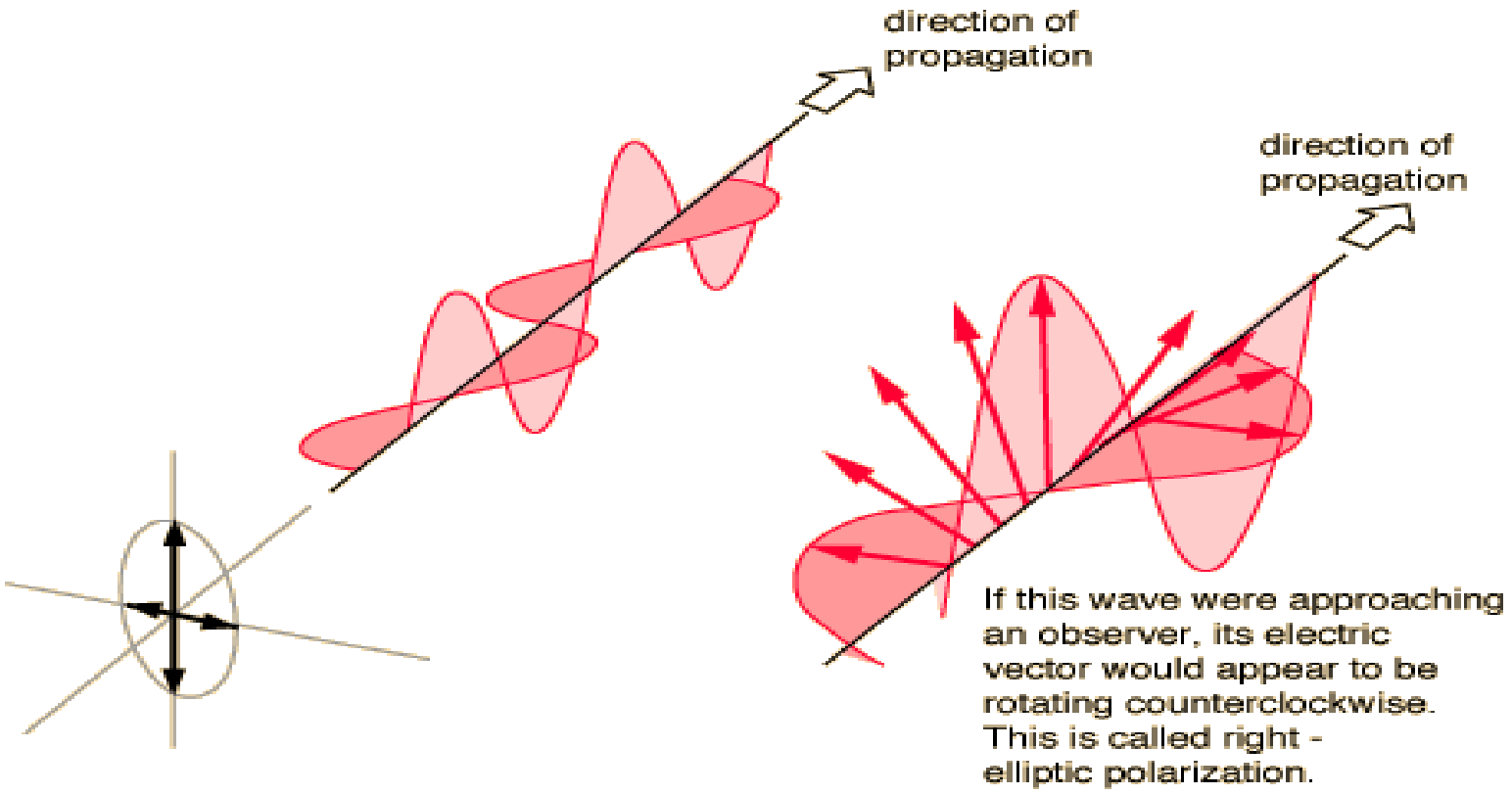
Circularly polarized light consists of two perpendicular electromagnetic plane waves of equal amplitude and 90° difference in phase. The light illustrated is right- circularly polarized.



If light is composed of two plane waves of equal amplitude but differing in phase by 90°, then the light is said to be circularly polarized. If you could see the tip of the electric field vector, it would appear to be moving in a circle as it approached you.

Elliptical Polarization

Elliptically polarized light consists of two perpendicular waves of unequal amplitude which differ in phase by 90°. The illustration shows right-elliptically polarized light.



The optical processes by which linearly polarized light can be produced

Linearly polarized light may be produced from unpolarized light using of the following five optical phenomena:

1. Reflection
2. Refraction
3. Scattering
4. Selective absorption (dichroism) and
5. Double refraction