

# Photonics

*Lecture 4*

## **Polarization**

**By**

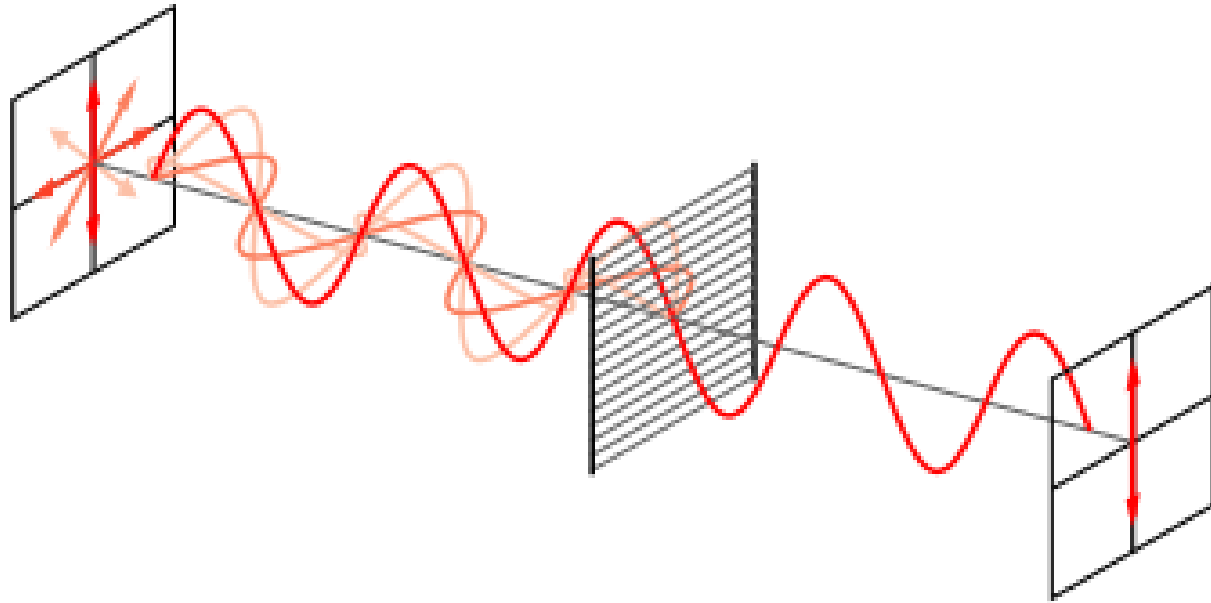
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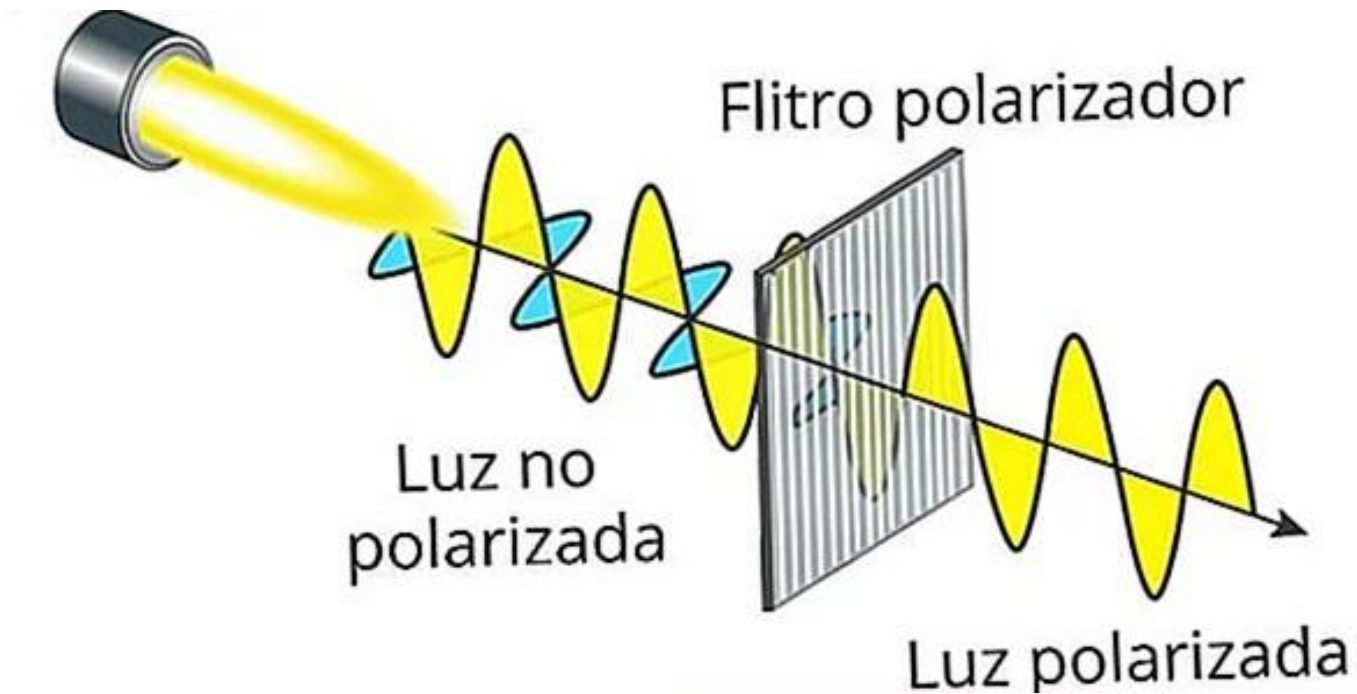
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**Polarization** is a property applying to transverse waves that specifies the geometrical orientation of the oscillations. In a transverse wave, the direction of the oscillation is perpendicular to the direction of motion of the wave.



An electromagnetic wave such as light consists of a coupled oscillating electric field and magnetic field which are always **perpendicular** to each other.

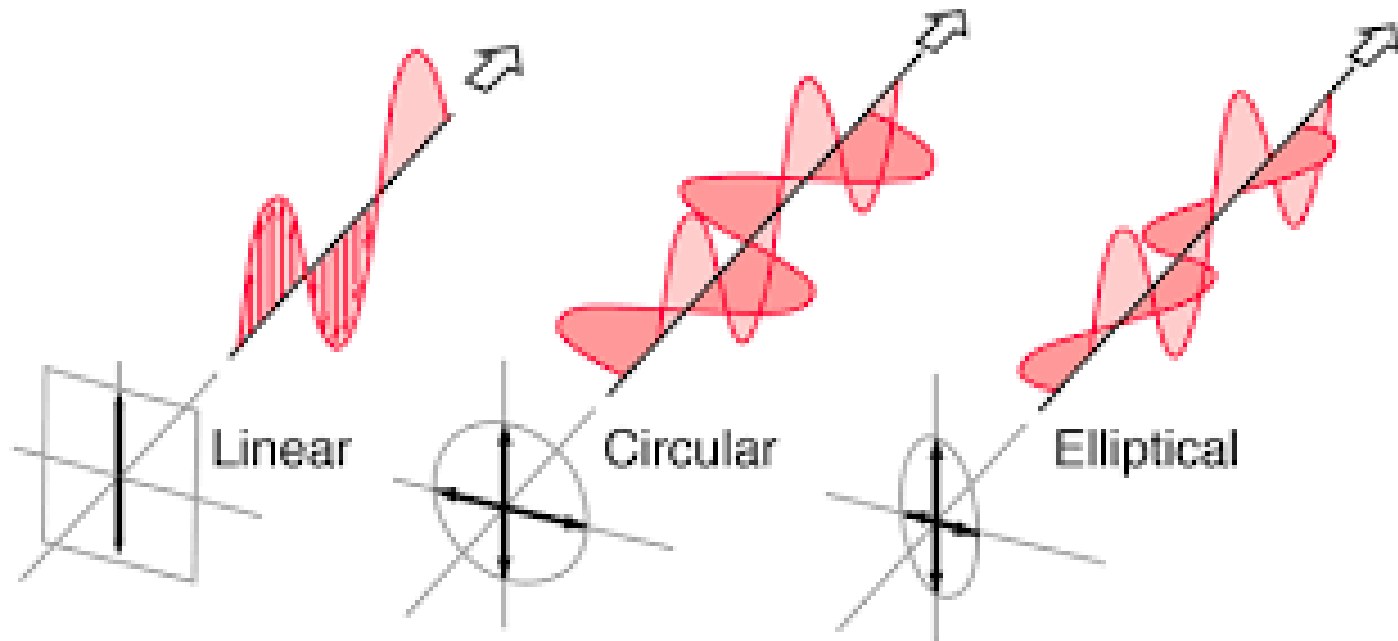


Polarized light can be produced by passing unpolarized light through a polarizer, which allows waves of only **one polarization** to pass through. The most common **optical materials** do not affect the polarization of **light**, however, some materials—those that **exhibit birefringence, dichroism, or optical activity**—affect light differently depending on its **polarization**. Some of these are used to make polarizing filters. Light is also partially polarized when it reflects from a surface.

# Types of Polarization

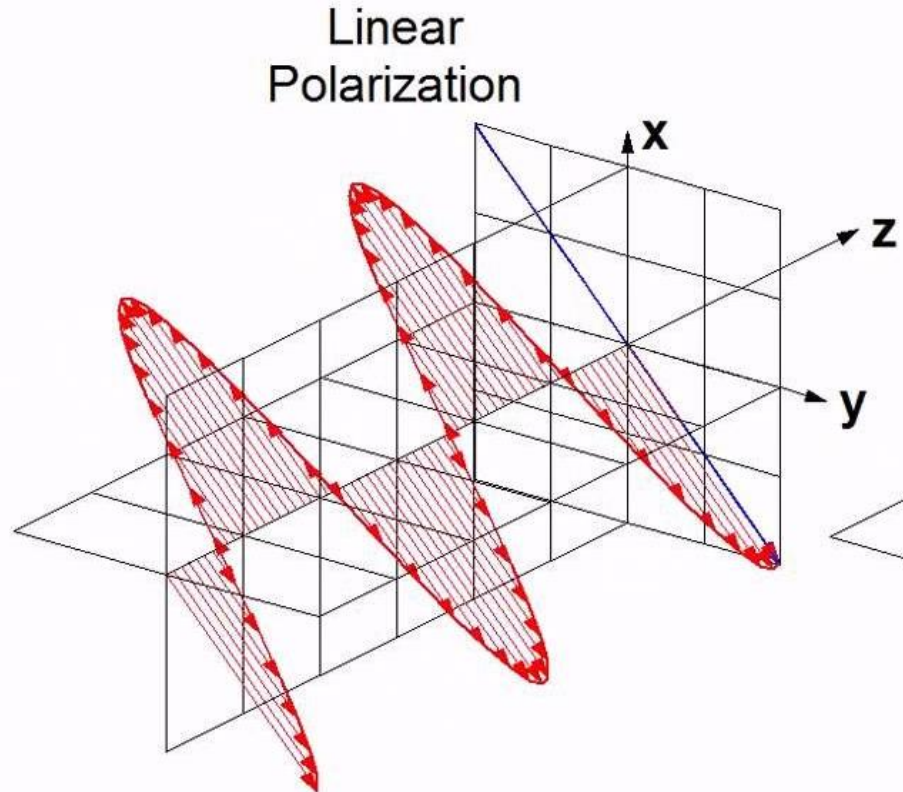
Following are the three types of polarization depending on the transverse and longitudinal wave motion:

- Linear polarization
- Circular polarization
- Elliptical polarization



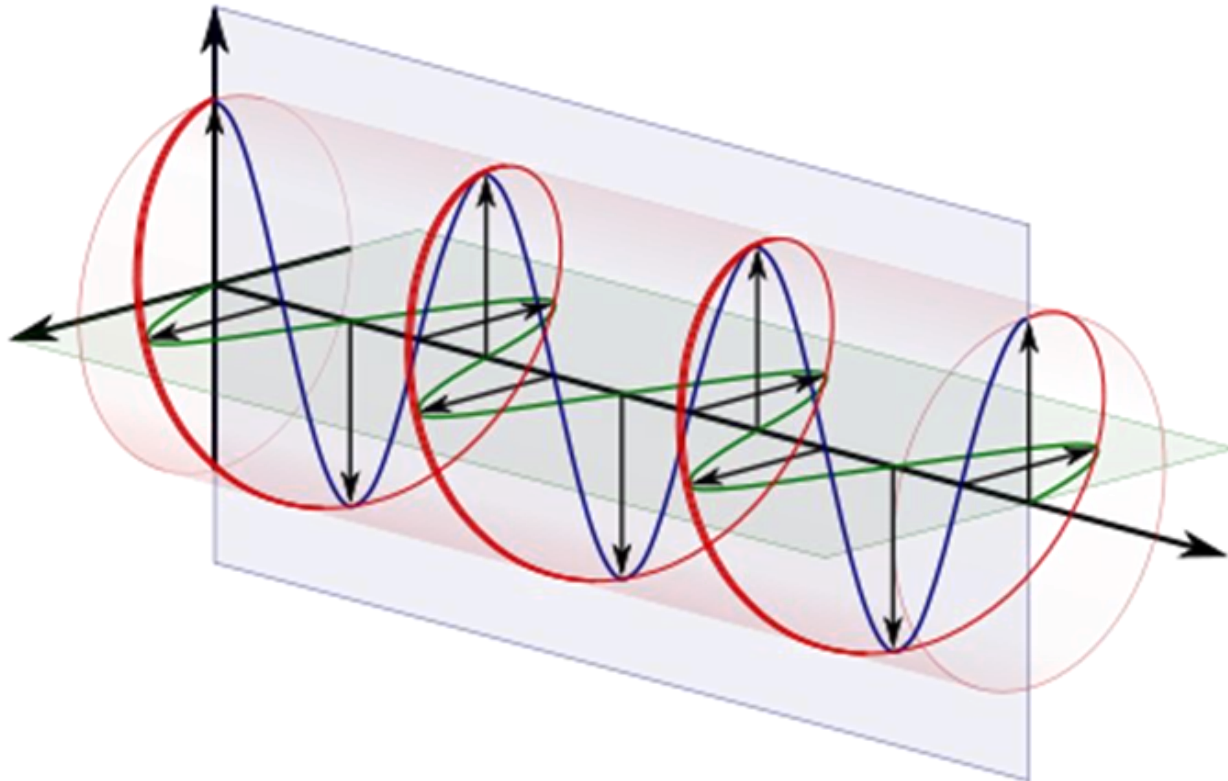
# Linear Polarization

In linear polarization, the electric field of light is limited to a **single plane** along the direction of propagation.



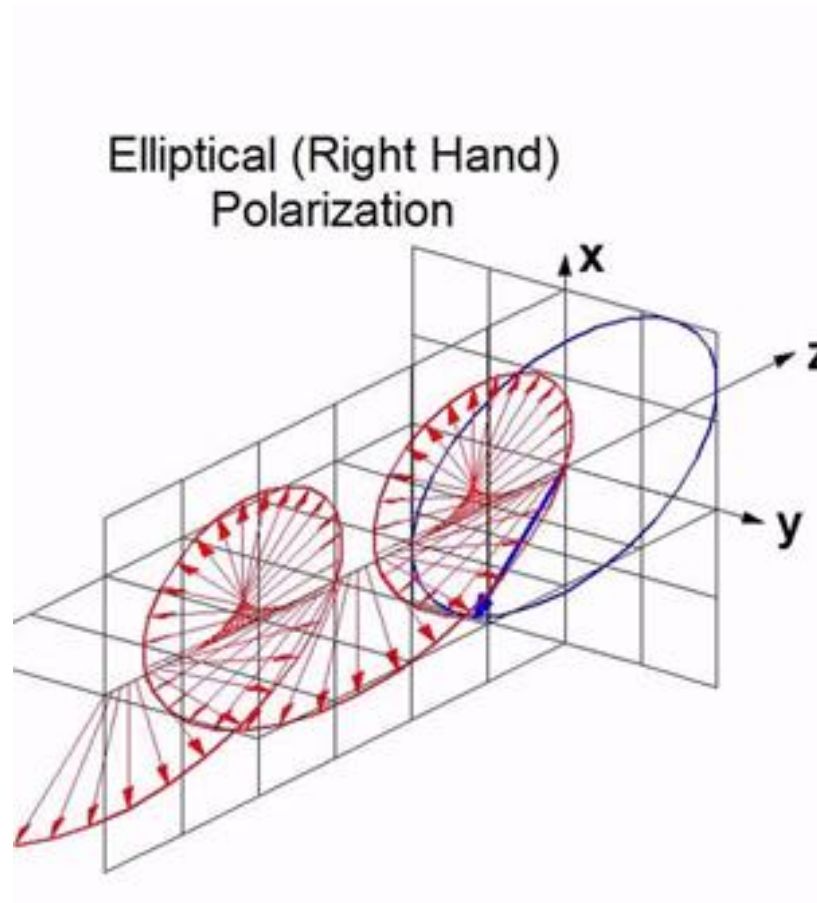
# Circular Polarization

There are **two linear** components in the electric field of light that are **perpendicular** to each other such that their **amplitudes are equal**, but the **phase difference is  $\pi/2$** . The propagation of the occurring electric field will be in a **circular motion**.



# Elliptical Polarization

The electric field of light follows an elliptical propagation. The **amplitude and phase difference** between the two linear components are not equal.





# Methods Used in the Polarization of Light

There are a few methods used in the polarization of light:

- ❖ Polarization by Transmission
- ❖ Polarization by Reflection
- ❖ Polarization by Scattering
- ❖ Polarization by Refraction

