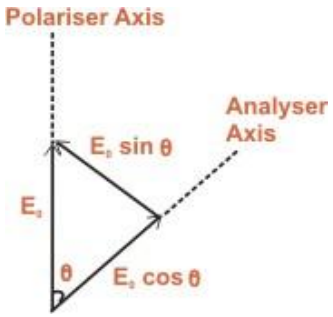
what is malus law of polarization?

Malus's Law

According to malus, when completely plane polarized light is incident on the analyzer, the intensity I of the light transmitted by the analyzer is directly proportional to the square of the cosine of angle between the transmission axes of the analyzer and the polarizer.

i.e $I \propto \cos^2\theta$



Suppose the angle between the transmission axes of the analyzer and the polarizer is θ. The completely plane polarized light form the polarizer is incident on the analyzer. If E_0 is the amplitude of the electric vector transmitted by the polarizer, then intensity I_0 of the light incident on the analyzer is $I \propto E_0^2$

The electric field vector E_0 can be resolved into two rectangular components i.e $E_0 \cos\theta$ and $E_0 \sin\theta$. The analyzer will transmit only the component (i.e $E_0 \cos\theta$) which is parallel to its transmission axis. However, the component $E_0 \sin\theta$ will be absorbed by the analyser. Therefore, the intensity I of light transmitted by the analyzer is,

$I \propto (E_0 \times \cos\theta)^2$

$I / I_0 = (E_0 \times \cos\theta)^2 / E_0^2 = \cos^2\theta$

$I = I_0 \times \cos^2\theta$

Therefore, $I \propto \cos^2\theta$. This proves law of malus.

When $\theta = 0°$ (or 180°), $I = I_0 \cos^2 0° = I_0$ That is the intensity of light transmitted by the analyzer is maximum when the transmission axes of the analyzer and the polarizer are parallel.

When $\theta = 90°$, $I = I_0 \cos^2 90° = 0$ That is the intensity of light transmitted by the analyzer is minimum when the transmission axes of the analyzer and polarizer are perpendicular to each other.