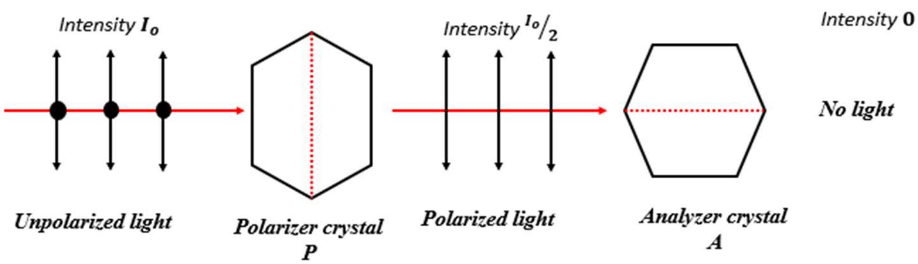
Step 3:

Both polarizer and analyzer are rotated parallelly, no change in intensity of polarized light is observed on passing through them.

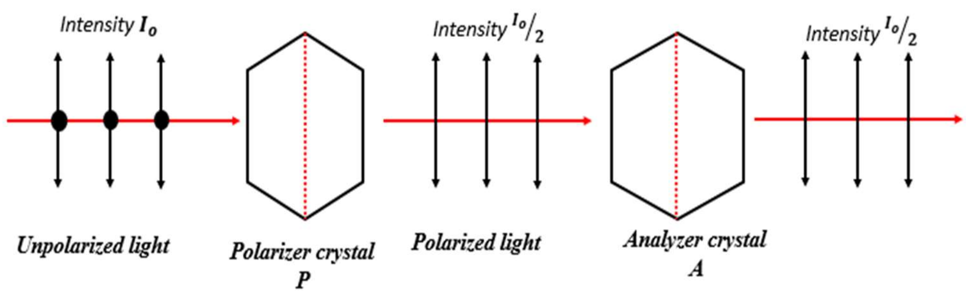
Step 4:

The axis of polarizer P is kept fixed & plane of analyzer A is slightly rotated. On doing so, the intensity of emergent beam decreases gradually and becomes zero when axis of A is exactly perpendicular to plane of P.



Step 5:

The analyzer crystal A is rotated, keeping the polarizer crystal P fixed. The emergent polarized light is gradually reappeared and finally attains maximum intensity when axis of both crystals is again parallel to each other.



This experiment shows that light is a transverse wave. If light waves were longitudinal, there would be no change in intensity of light due to the rotation of *Analyzer crystal A*.

Malus law:

Statement:

"The intensity of plane-polarized light that passes through (emerges from) an analyzer varies directly with the square of the cosine of the angle between the transmission axes of the polarizer and the analyzer"

If θ be the angle between the transmission axes of polarizer and analyzer, then according to Malus law: $intensity\ of\ emergent\ light, \boldsymbol{I} \propto \boldsymbol{cos^2\theta}.$

Proof:

Consider an unpolarized light with certain intensity is incident on a polarizer (P). The component light parallel to the transmission axis of the polarizer are allowed to pass through it and the perpendicular components are absorbed.

If E_o be the amplitude of electric field vector transmitted through polarizer, then corresponding intensity is:

$$I_o \propto {E_o}^2 \ldots \ldots \ldots (1)$$

Now, place a analyzer (A) just behind the polarizer (P) such that the angle between the transmission axes is θ, as shown in figure.