BASIC OF WAVES

Wave :- Wave is a disturbance which transports momentum and energy from one place to another place in space without transporting the particles of the medium. particles of medium oscillate only about their mean position.

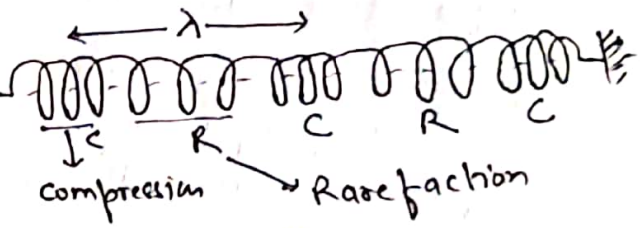
Waves are classified into two categories on the basis of motion of particles of a medium through which waves are propagated.

(i) Longitudinal wave (ii) Transverse wave.

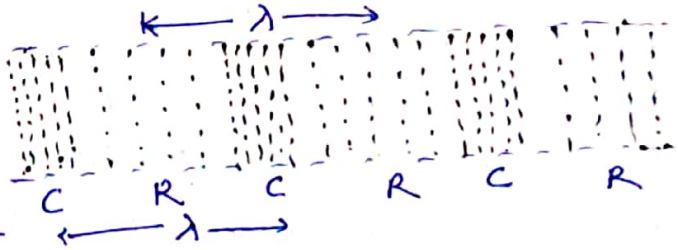
* Longitudinal wave :- The wave in which particles of medium oscillate to and fro about their mean position along the direction of propagation of wave, is known as Longitudinal wave.

Example :- Sound waves, waves produced on a spring etc are example of longitudinal wave.

Longitudinal wave consists of alternate compressions and rarefactions as shown in figure.



One compression and one rarefaction together form a wave.



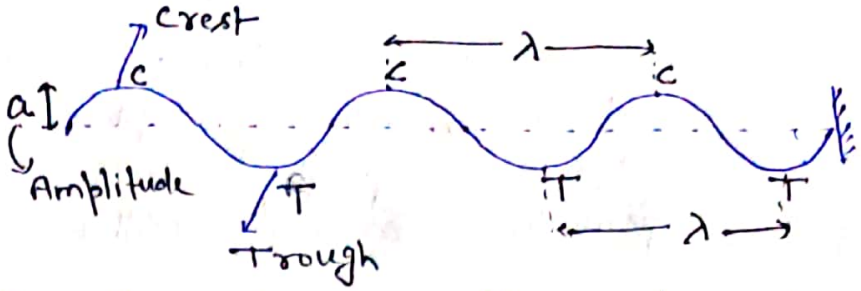
Distance between two consecutive compressions or two consecutive rarefactions is wave length (λ).

* Transverse wave :- The wave in which particles of medium oscillate about their mean position along the direction perpendicular to direction of propagation of wave, is known as Transverse wave.

Example :- Waves on ~~stretched~~ string, waves on water surface (ripples), all electromagnetic waves etc are example of Transverse waves.

Basic of waves

A transverse wave consists of alternate crests and troughs as shown in figure.



One crest and one trough combine together to form a wave.

Distance between two consecutive crests or two consecutive troughs is wave length (λ).

Maximum displacement of particle of medium from its mean position is amplitude (a).

* In a longitudinal wave, all directions perpendicular to the direction of propagation of wave are equivalent.
* In a transverse wave, a preferential direction normal to the direction of wave propagation exists. The preferential direction in a transverse wave is the direction of vibration of particles of the medium through which the wave is propagating. This preferential direction is different from all other directions.
* The existence of a preferential direction for a transverse wave leads to the characteristic phenomenon known as polarisation.
* polarisation is not found with longitudinal wave because longitudinal waves do not possess directional property.
* polarisation is specific to transverse wave.

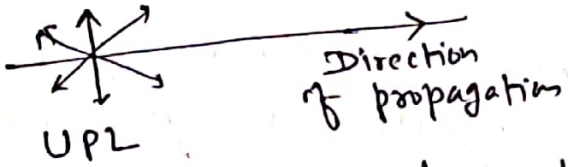
* Light waves are transverse (electromagnetic waves) waves consisting of electric and magnetic fields vibrating perpendicular to each other and also perpendicular to direction of propagation of wave. The direction of vibration of electric field vector and the direction of propagation of wave constitute a plane known as plane of polarisation.

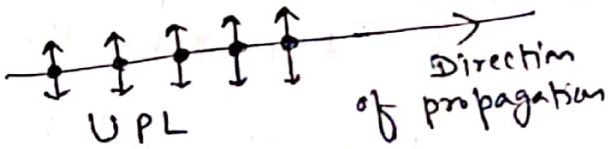
There are infinite number of such planes around the direction of propagation of wave. In ideal light wave, the vibration of electric field vector are confined to a single plane. But in practice, light sources emit a mixture of light waves whose planes of vibrations are randomly oriented about the direction of propagation. Such random orientations of vibration planes gives rise to symmetry about the wave propagation.

* Unpolarized light :- Natural light is unpolarised light. The light wave in which electric field vector $\vec{E}$ vibrates in more than one plane perpendicular to the direction of propagation of light wave, is known as unpolarised light.

Light emitted by the sun, by an incandescent lamp, by a candle flame, is unpolarized light.

Symbollic representation of unpolarized light is





* polarized light :- polarised light can not be produced naturally. polarised light can be obtained by converting unpolarised light into polarised light using optical devices like tourmaline crystal or Nicol prism or polaroid etc.

The light wave in which electric field vector $\vec{E}$ vibrates in one specific (particular) plane, is known as polarised light.

The light wave in shown figure, is polarised light wave because electric field vector $\vec{E}$ vibrates in one plane only (XY plane).

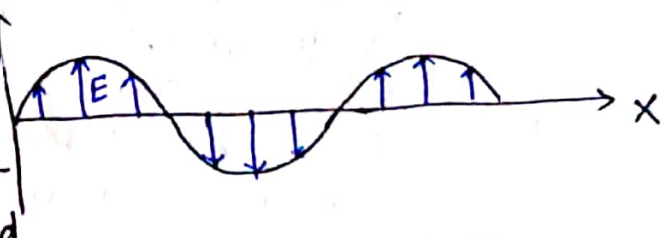
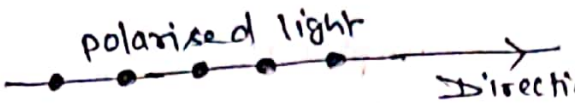


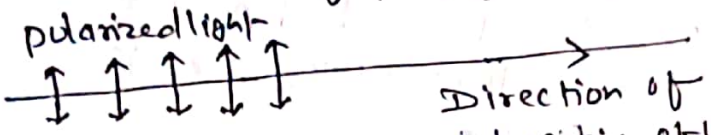
Fig: polarised light

The direction of vibration of electric field vector $\vec{E}$ and the direction of propagation of wave constitute (form) a plane. This plane is known as plane of polarisation of light wave. Thus XY plane is the plane of polarisation as shown in the figure.

Symbollic representation of polarized light has been shown in figures.



It is vertical polarization.



It is horizontal polarisation.

* In vertical polarization, the electric field vector oscillates inward and outward the plane of paper and perpendicular to the direction of propagation of wave.
* In horizontal polarization, the electric field vector oscillates left and right to the direction of propagation of light wave.

* **polarization of light:-** The phenomenon of producing polarised light from unpolarized light, is known as polarization of light. i.e, the phenomenon of bringing vibration of electric field vector from different planes into one specific (particular) plane, by using some optical elements, is known as polarization of light.

* **polarizer:-** The optical device which is used to produce polarised light from unpolarised light, is known as polarizer. Nicol prism, polaroid etc are used as polarizer.

* **Analyser:-** The optical device which is used to detect whether the light is polarized or unpolarized, is known as Analyser. Nicol prism, polaroid etc can also be used as analysers.