DDU GORAKHPUR UNIVERSITY, GORAKHPUR, UTTAR PRADESH

Department of Physics

Syllabus and Units Cover by Dr. Sintu Kumar from

Paper II: Oscillations and Waves

Course: B.Sc. I Year

Wave Motion: Wave motion and its parameters, stationary waves, Wave velocity and group velocity.

Ultrasonic: Production, properties and uses of ultrasonic waves, Acoustic grating.

Fourier analysis: Fourier theorem, evaluation of Fourier coefficients, analysis of (i) square wave, (ii) sawtooth wave, (iii) half and full wave rectifiers output.

Acoustics: The acoustics of Halls, Reverberation time, Sabine's formula.

Reading Books

- The Physics of Waves and Oscillations by N.K. Bajaj

Reference Book for uploaded lectures

- The Physics of Waves and Oscillations by N.K. Bajaj

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Wave Motion (waving)

A wave is a self-propagating disturbance in a medium. Waves carry energy, momentum, iformation, but not matter.

Example

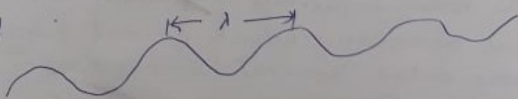
* sound wave (Pressure wave) in air (or in any gas or solid or liquid)
* waves on a streched string
* waves on the surface of water
* EM-waves (light) - this is only one kind of wave which doenot ~~have~~ require a medium. EM-wave can travel in vacuum.

⇒ We can use a wave to send a signal (information) without sending any matter.

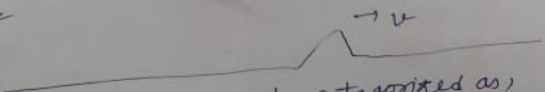
⇒ The thing is that is waving in an EM wave is an EM field which generates itself as it propagates In sense, an EM wave "roll out" in its own carpet, creating its own medium as it moves forward. More on EM - later.

⇒ Traveling wave can be categorized as,

Sinusoidal



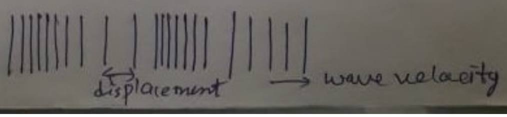
Impulse



Traveling wave can also be categorized as,

Transverse:- Displacement of medium is perpendicular (transverse) to the direction of wave motion/ ~~velocity~~ v (like a wave on water or a string)

Longitudnal Displacement of medium is parallel to the direction of wave ~~velocity~~/motion (like sound wave)



For a sinusoidal wave, the wave speed is

$$v = \frac{\text{distance}}{\text{time}} = \frac{1 \text{ wavelength}}{\text{time for } 1\lambda \text{ to go by}} = \frac{\lambda}{T}, \; T = \text{period}$$

$$\boxed{v = \frac{\lambda}{T} = \lambda f} \qquad \left(\text{since frequency } f = \frac{1}{T}\right)$$

⇒ Almost, always, the wave speed v is a constant independent of λ and T.

⇒ The wave speed v depends on the properties of the medium, not on the properties of the wave

Example:

Medium = string, properties = tension, mass per length

Medium = air, properties = temperature, mass per molecule etc.

EM waves in vacuum: wavespeed = speed of light = fixed.

$v = \lambda f$ = constant ⇒ λ increases as f decreases

λ - decreases as f increases.

Note:- The wave requiring a medium are called Mechanical wave and which do not require a medium are called non-mechanical waves.