3.4 Travelling or Progressive wave:

Progressive wave:

In a travelling or progressive wave,the energy is transferred from one place to another by continuous vibration of the particles in an elastic material medium about their equilibrium position.

Wave Equation of a progressive wave:

If the progressive wave is propagating in a medium along the positive X-axis then the position of particles O,A,B,C,D …….

As the wave propagates all the particles of the medium begin to vibrate to and fro about their mean positions.The curve joining these points represents the progressive wave.

Let the particle begin to vibrayte from origin O at time t=0.If y is the displacement of the particle at time t,then equation of particle executing simple harmonic motion about O is

$y = A\sin wt$ ---------(1)

A- Amplitude

ω-angular velocity

If v is the speed of wave and C is particle at a distance x from O,then the time taken by wave to reach point C is $\frac{x}{v}$ seconds.

The displacement of particle c at any time 't' will be $(t - \frac{x}{v})$

The displacement of C is

$y = A \sin \omega(t - \frac{x}{v})$ ----------(2)

$\omega=\frac{2\pi}{T}$

$y= A \sin \frac{2\pi}{T} (t - \frac{x}{v})$

$y= A \sin \frac{2\pi}{T} (\frac{t}{T} - \frac{x}{vT})$ ----------(3)

but $vT = \lambda$

$y = A \sin 2\pi\left(\frac{t}{T} - \frac{x}{\lambda}\right)$

$y = A \sin\frac{2\pi}{\lambda}\left(\frac{t\lambda}{T} - x\right)$

$y = A \sin\frac{2\pi}{\lambda}(vt - x)$----------(4)

$y = A \sin (wt - kx)$----------(5)

Equations (2),(3),(4) and (5) represents the equation of a plane progressive wave.