CONCEPT MAP

Waves

Wave Motion : It is a means of transferring energy and momentum from one point to another without any actual transportation of matter between these points.

Transverse Wave : Individual particles of the medium execute simple harmonic motion about their mean position in a direction perpendicular to the direction of propagation of wave motion.

Speed of transverse wave, $v = \upsilon\lambda$

Speed of transverse wave on a stretched string,

$$v = \sqrt{\frac{T}{\mu}}$$

Longitudinal Wave : Individua particles of the medium execut simple harmonic motion about thei mean position along the sam direction along which the wave i propagating.

Sound waves are longitudinal mechanical waves.

- Speed of sound wave in solids
$$v = \sqrt{\frac{Y}{\rho}}$$
- Speed of sound wave in fluid,
$$v = \sqrt{\frac{B}{\rho}}$$
- Speed of sound wave in gas,
$$v = \sqrt{\frac{\gamma P}{\rho}}$$

nciple of Superposition : When any nber of waves meet simultaneously at a nt in a medium, the net displacement at iven time is the algebraic sum of the placement due to each wave at that e.

Standing Waves : When two sets of progressive wave trains of the same type traveling in same straight line in opposite direction superimpose, standing waves are formed.

Nodes : Points where amplitude of vibration is zero.

Antinodes : Points where amplitude of vibration is maximum.

ts : The phenomenon of alternate ation in the intensity of sound with e at a particular position, when two nd waves of nearly same frequencies amplitudes superimpose on each other. t frequency = number of beats per ond = difference in frequency.

On String

Organ Pipe

Organ Pipe Closed at One End: Frequency of n^{th} normal mode of vibration,

$$\upsilon_n = (2n-1)\upsilon_1$$

The frequency of fundamental mode is

$$\upsilon_1 = \frac{v}{4L_C}$$

Organ Pipe Open at Both Ends: Frequency of n^{th} normal mode of vibration

$$\upsilon_n = n\upsilon_1$$

The frequency of fundamental mode is

$$\upsilon_1 = \frac{v}{2L_O}$$

Equation of plane progressive wave travelling with a velocity v along positiv direction of x-axis is

$$y = a\sin(kx - \omega t + \phi)$$

where $(kx - \omega t + \phi)$ is the phase.

The wavelength of nth mode of vibration of a stretched string is

$$\lambda_n = \frac{2L}{n}$$

and its frequency is

$$\upsilon_n = n\upsilon_1$$

The fundamental frequency of vibration of a stretched string

$$\upsilon_1 = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$$

Doppler Effect : According to this effect, whenever there is a relative motion between a source of sound and listener, the apparent frequency of sound heard by the listener is different from the actual frequency of sound emitted by the source.

Apparent frequency, $\upsilon' = \dfrac{(v \pm v_o)\upsilon}{v \mp v_S}$

where υ is the actual frequency of sound emitted.

The upper sign on v_S (or v_o) is used when source (listener) moves towards the listener (source) while lower sign is used when it moves away.

Symbols Used

a = amplitude of wave
v_o = velocity of observer
μ = linear mass density
ρ = density
L = length of the string
v = velocity of sound
Y = Young's modulus
B = Bulk modulus
υ_1 = fundamental frequency
γ = ratio of specific heats
L_C = length of the closed pipe
L_O = length of the open pipe
v_s = velocity of source
T = tension in the string
P = pressure