TOPIC 3 – SOUND WAVES:

- Source of sound waves is always a vibrating object. Common vibrating objects are beating of drum, loudspeaker, tuning forks, human vocal cords etc.
- Sound waves are longitudinal waves i.e. the particles of the medium vibrate parallel to the direction of the waves.
- Sound waves travel through the medium due to the compression and rarefaction of the particles of the medium. Compression means when the particles of the medium are closer together and rarefaction means when the particles are farther apart from each other.



- Human ear can only hear sound waves of frequencies in the range of 20 Hz to 20,000Hz. This is called the audible range. The upper limit of audible range decreases with increasing the age of a person.
- When sound waves reflected from the hard surface it creates an effect of echo. If the distance between the source of sounding body and reflecting surface is more than 15m then human ears can hear echo. The concert halls are designed by using very special material that can absorb sound. The expression use to calculate the distance between source and reflecting surface during the echo.

 $v = \frac{2d}{t}$ where *d* is the distance between source and reflecting surface, *v* is the speed of sound and *t* is the time.

Speed of sound waves:

The speed of sound waves can be measured by a simple experiment. For this experiment we need a stopwatch, a measuring tape, sound making objects for example two wooden blocks, shot gun etc.

Consider two students A and B are standing next to each other in a play ground outside the school building. Student A will make the sound by banging two wooden blocks. Student B will hear two bangs, one bang directly from the banging of two blocks and second bang after hearing the reflection of sound waves from the school wall. He will start his stopwatch when he hears the first sound and stop the stopwatch when he hears the second sound. The time is measured between the two bangs. It is the total time taken by sound to cover twice the distance between the students and the wall. The speed of sound waves can be calculated by the following formula.

Speed of sound wave = $\frac{2 \times \text{the distane between the wall and the students}}{\text{total time noted on the stopwatch}}$

The accuracy of the experiment can be increased by

- 1. Find performing the experiment three times and finding the average.
- 2. By performing the experiment along the different directions of wind and then finding the average as the direction and speed of wind affect the speed of sound waves



• Speed of sound is greatest in solids then in liquids and gases.

Material(medium)	Air (0°C)	Water	Concrete (wall)	Steel
Speed (m/s)	330	1400	5000	6000

• In air the speed of sound increases with the increase of temperature; however the change of pressure has no effect on it.

Ultrasonic Waves:

Sound waves whose frequency is above 20,000Hz is called ultrasonic waves.

- Ultrasonic waves produce by quartz crystal oscillator.
- Bats emit ultrasonic waves to judge the distance in front of them.
- Sonar uses it to determine the depth of water.
- It is also used in pre-natal clinic to monitor the health of unborn babies. It has no harmful effects.

Properties of sound waves:

Pitch:

Pitch of a musical note depends upon the frequency of the sound waves reaching our ears. High pitched sound waves have high frequency and short wavelength.

Loudness:

A note or sound becomes louder when more sound energy enters our ears per second. This happens when the source is vibrating with larger amplitude for example violin string bowed more strongly.

Regular vibration:

Pleasant sound such as the sound from musical instrument is called regular vibration. It is also called musical notes.

Irregular vibration:

Unwanted sound for example those of motor engine are called irregular vibration and it creates noise. A noise signal consists of a mixture of frequencies with random amplitudes.

