3.1 ACOUSTICS-Introduction

Sound waves are classified into three categories on the basis of frequency.

1. Infrasonics (below 20 Hz)
2. Audible sound (between 20 Hz to 20,000 Hz)
3. Ultra sound (above 20,000 Hz)

Audible sound is further classified as

a) **Musical sound** which produces pleasing effect on the ear.
b) **Noises** which produces unpleasant effect on the ear.

Characteristics of musical sound

a) **Pitch** – Pitch is the characteristic of sound that distinguishes between a shrill sound and a grave sound.
b) **Quality** – The quality of sound is that characteristic which enables us to distinguish between two notes of the same pitch and loudness produced by two different voices.
c) **Intensity of sound** – It is the energy of sound wave crossing per unit time through unit area at right angles to the direction of propagation.
d) **Loudness** – It is the degree of sensation produced in the ear.

Loudness

Loudness of the sound is defined as the degree of sensation produced on the ear. It varies from one listener to another. Loudness is different from intensity of sound.

Loudness is a physiological quantity. It is difficult to measure because it depends upon the individual listener. However, it is measured as the logarithmic value of intensity.

Weber-Fechner law

Loudness of sound is defined as the degree of sensation produced on the ear. This cannot be measured directly. So that it is measured in terms of intensity. Loudness is proportional to logarithmic
value of intensity.

$$L \propto \log I; \qquad L = k \log I$$

\

Sound Intensity Level

It is the ratio of intensity of a sound (I) to the standard intensity of sound (I_o) .
$= \log_{10} (I/I_o)$

Bel :

One bel is defined as the relative intensity between two sound notes if one is 10 times more intense than the other.

Decibel:

It is the smallest unit compared to Bel. It is the standard unit used to measure the loudness. One decibel is equal to one tenth of bel. An increase of sound intensity level by 1 dB would increase the intensity by 26 %.

Absorption coefficient

The absorption coefficient of a material is defined as the ratio of the sound energy absorbed by the surface to that of the total sound energy incident on the surface.

$$a = \frac{\text{Sound energy absorbed by the surface}}{\text{Total sound energy incident on the surface}}$$

The absorption coefficient can also be defined as the rate of sound energy absorbed by a certain area of surface to that of an open window of same area.

$$a = \frac{\text{Sound energy absorbed by } 1m^2 \text{ of surface}}{\text{Sound energy absorbed by } 1m^2 \text{ of open window}}$$

Reverberation time

The persistence of audible sound, even after the source has stopped to emit the sound is called reverberation. The time during which the sound persists in the hall is called as reverberation time.

Reverberation time is also defined as the time taken by the sound to fall to one millionth of its original intensity, after the source of sound is stopped.

When the reverberation time is lower than the critical value, sound becomes inaudible by the observer and the sound is said to be dead and if the reverberation time is too large, echoes are produced. Therefore, the reverberation time should have some optimum value.