(Management Topic in Environmental Studies)

B. Tech 7TH Semester

Noise pollution

Department: Chemistry
Subject: MTES (CHM 2049)

Contents

Noise Pollution

Introduction

- It is an unpleasant and disturbing sound, responsible for several auditory and no-auditory adverse effects on human health and well-being, ranging from simple annoyance to hearing loss.
- According to WHO, Noise is considered as a major concerned environmental factor for an unhealthy society (WHO, 2011)
- Noise is a perpetual, significant contributor to occupational diseases in numerous working environments.
- Noise health effects depend on the combination of intensity, frequency and duration of exposure to noise

Sources of Noise Pollution

Industries

Rail and Air traffic

Road traffic

Construction

Indoor sources

Loud speakers

Fire crackers

Properties of Sound

- Physically: Sound is a mechanical disturbance propagated as a wave motion in air and other elastic and mechanical media such as water or, steel.
- Physiologically: Sound is an auditory sensation evoked by this physical phenomenon.(not all sound wave evoke an auditory sensation, e.g., the frequency of ultrasound is too high to excite the sensation of hearing)
- Sound waves involve a succession of compressions and rarefactions of an elastic medium such as air.
- The sound waves are characterized by: the amplitude of pressure changes, their frequency and the velocity of propagation.

Wavelength=speed of Sound/ frequency.

Speed of sound in air(20°C)=344 m/s.
Sound travels much faster in solids than in air.
(wood=3,962 m/s, Steel=5,029 m/s)

frequency

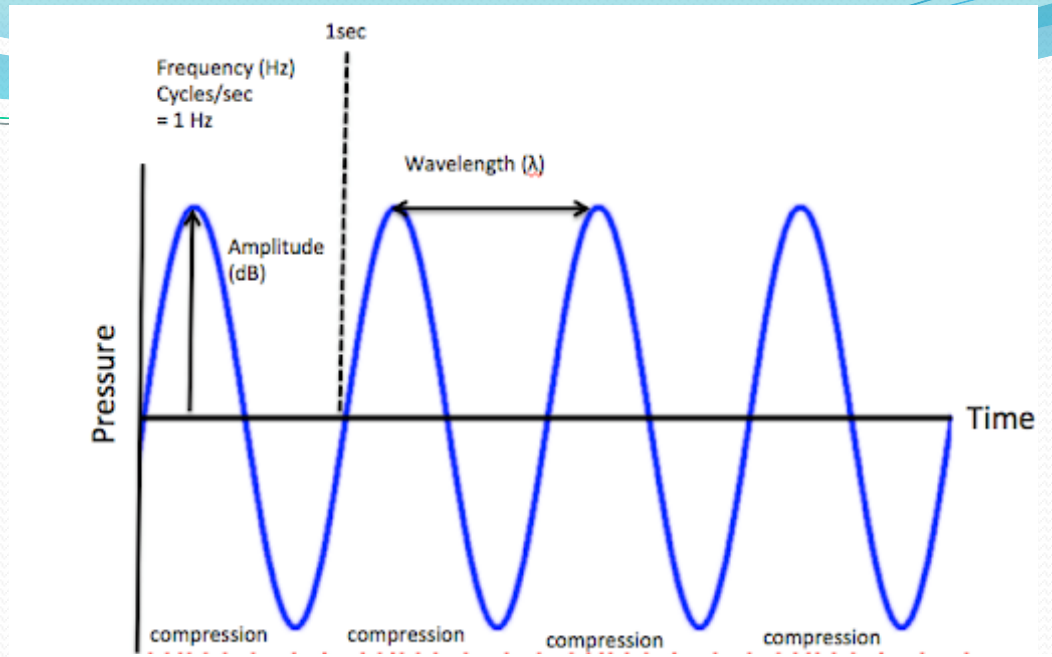
Number of compressions and rarefactions per unit time (sec)

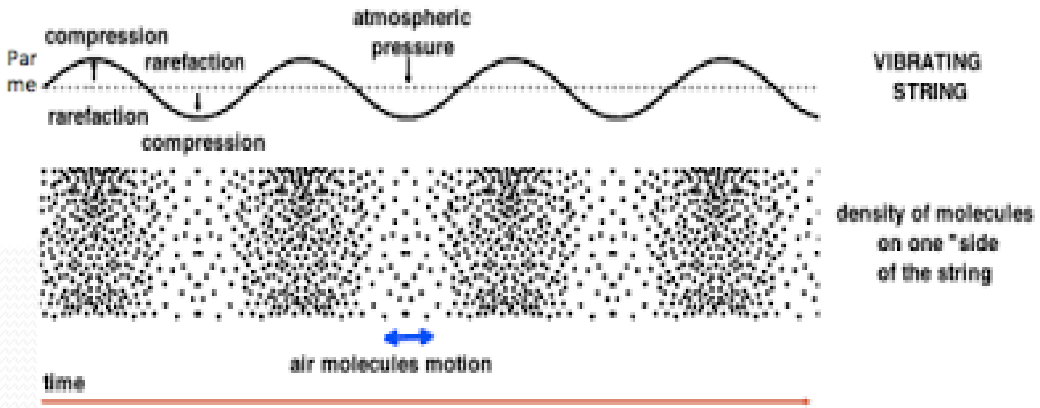
unit=hertz(Hz)

Sound Power

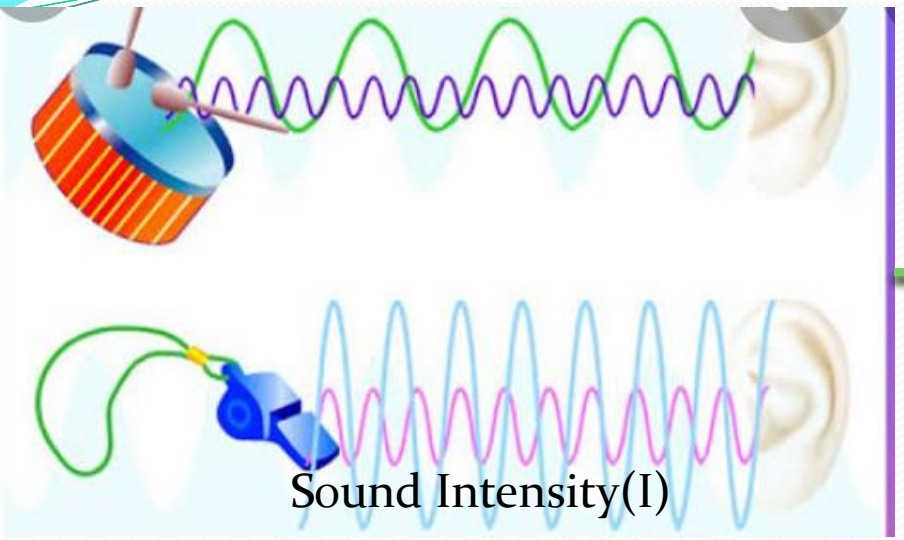
Rate at which energy is transmitted by a sound wave

Represented in terms of watt. Watt=Joules/Sec





Frequency range (20-20,000 Hz)



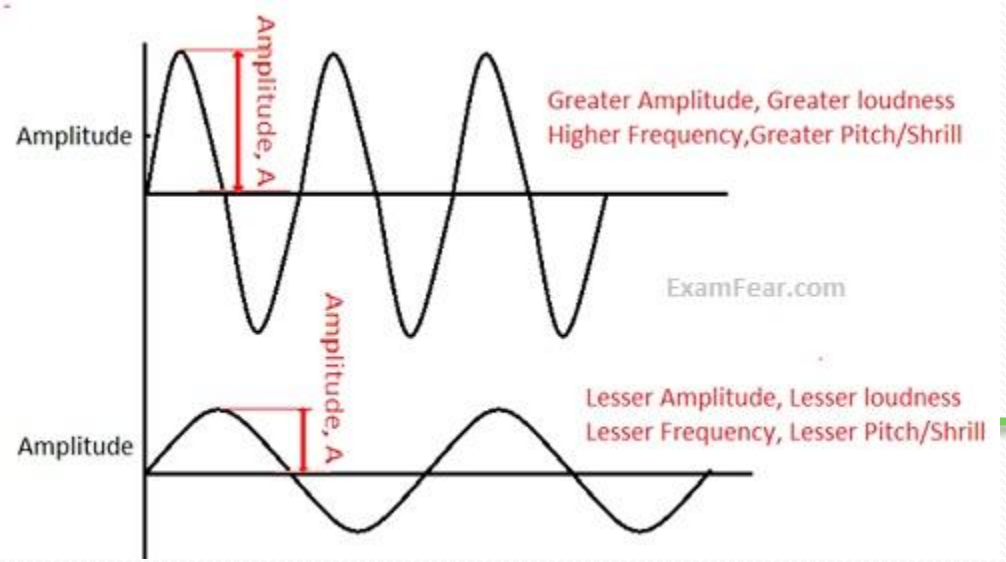
Sound Intensity(I)

Average sound power per unit area in the direction of propagation of sound wave.

$I=W/A \quad (watt/m^2)$

For a vibrating sphere,

$I= W/4\pi r^2$



When Noise is far away from the source, Sound intensity (I)

$I=P^2/\ell e$

P=Sound Pressure

ℓ=Density of the medium i.e., air=1.185

e=speed of Sound i.e.,340m/sec.

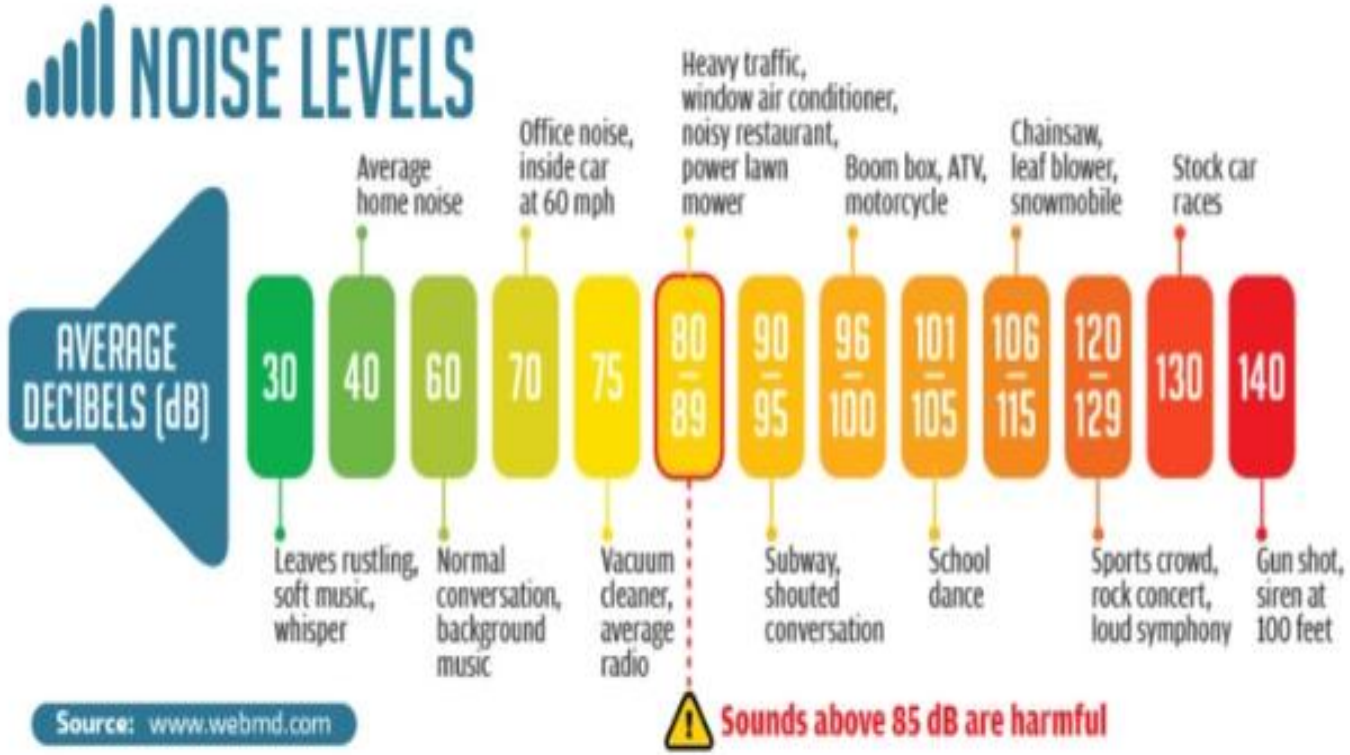
Decibel

- A scale ten times the logarithm of the ratio of a measured quantity to specified reference quantity.
- It represents sound level.

Sound power level, $L_w = 10\log_{10}(W/W_0)$

W=measured Sound power

W_0=Reference sound power(10^{-12}W)



Sound pressure level (Lp)

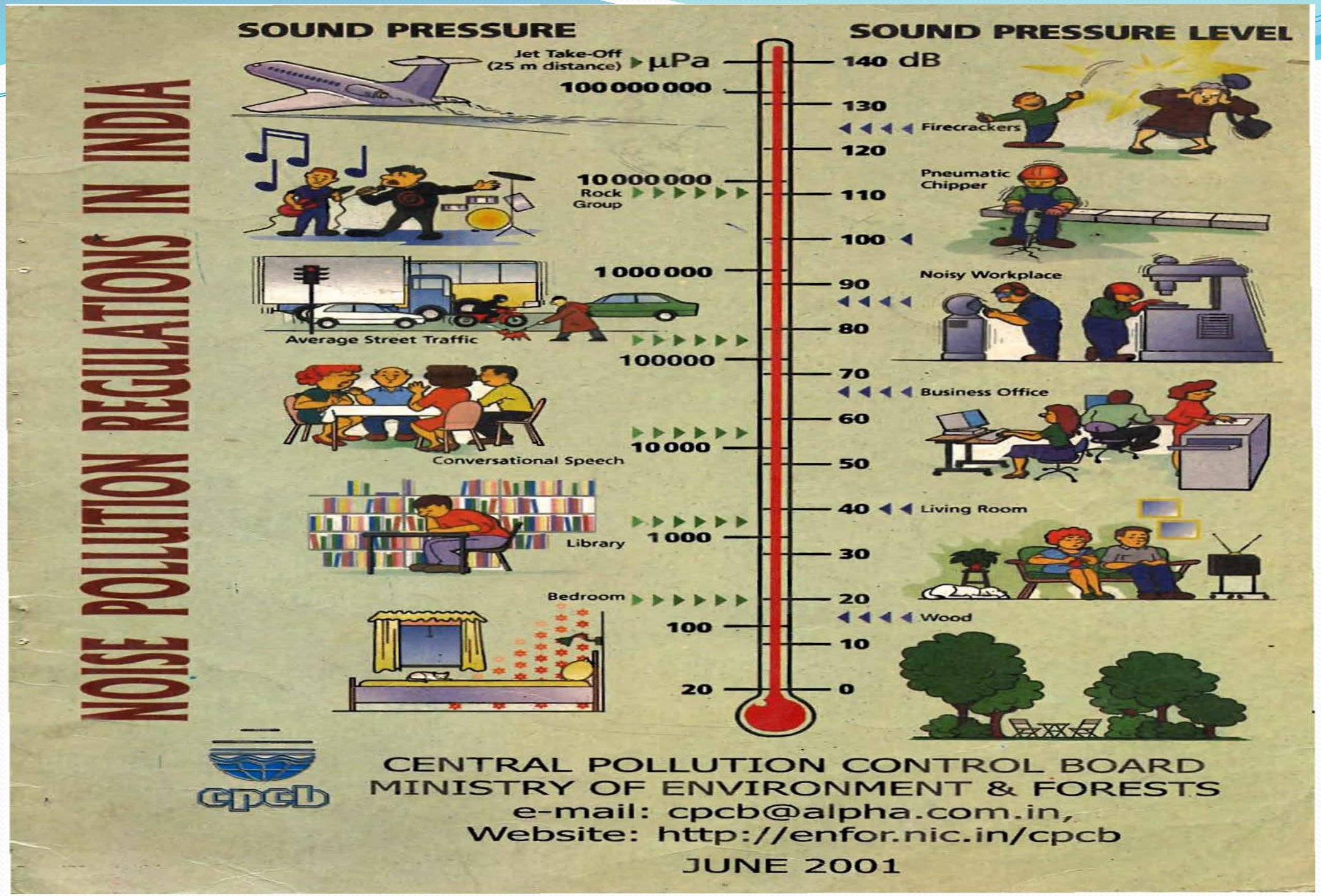
Sound is measured with a Sound level meter which is usually a portable self contained instrument incorporating a microphone amplifier, a voltmeter and a attenuator. The whole of which is calibrated to read sound pressure level directly.

Sound pressure level,
$Lp(dB)=10\log_{10}(P/P_r)^2$.....(i)
P=measured Sound Pressure
P_r=Reference sound Pressure(20μp)

Average sound pressure levels

$$\overline{Lp} = 20log\frac{1}{N}\sum_{j=1}^{N} 10^{(\frac{Lj}{20})} \text{.....(ii)}$$

$\overline{Lp}$=Average Sound pressure level.
Lj=The jth sound pressure level.
j=1,2,3.....N


NOISE POLLUTION REGULATIONS IN INDIA
SOUND PRESSURE
SOUND PRESSURE LEVEL
Jet Take-Off (25 m distance)
µPa
dB
100000000
140
130
120
10000000
Rock Group
110
100
1000000
90
80
Average Street Traffic
100000
70
60
10000
Conversational Speech
50
40
1000
Library
30
Bedroom
20
100
10
20
0
Firecrackers
Pneumatic Chipper
Noisy Workplace
Business Office
Living Room
Wood
CENTRAL POLLUTION CONTROL BOARD
MINISTRY OF ENVIRONMENT & FORESTS
e-mail: cpcb@alpha.com.in,
Website: http://enfor.nic.in/cpcb
JUNE 2001

Problems

1. The sound power generated from a moving tractor is 0.001 watt. What is the Sound Power Level?

Ans-

As we know, $L_w = 10\log_{10}(w/w_0)$

$= 10\log(0.001/10^{-12})$

$= 90$ dB

2. If a sound source has a pressure of 2000μp at 10m distance. Configure the sound pressure level in dB?
   - Sound Intensity in watt/m^2.
   - Sound Power in watt. (w?/Lw)

Ans-

As we know, $L_p(dB) = 10\log_{10}(P/P_r)^2$

$= 10\log(2000/20)^2$

$= 40$dB

ii. As we know, $I = P^2/\ell e$

$= (2000\times10^{-6})^2/(1.185\times340 m/s)$

$= 9.9\times10^{-9}$ watt/m^2.

iii. Given, r=10m

Here measured sound power is not given.

So, $I = W/4\pi r^2$

$I = w/4\pi r^2$

$\Rightarrow 9.9x10^{-9}=W/4x3.14x100$

$\Rightarrow W= 1.24x10^{-5}$watt

So, $Lw=10\log_{10}(w/w_o)$

$=>Lw=10\log((1.24x10^{-5})/10^{-12})$

$=>Lw=71$ DB

3. Determine the sound power level by combining 5 sound levels i.e., 61 dB, 54 dB, 73 dB, 67 dB and 45dB?

Ans. $Lw_a=10\log_{10}(Wa/W_o)$

$=>Wa = Wo \times 10^{Lwa/10}$

$=>Wa=Wox10^{61/10}$

Here, $Lw_a=61dB$, $Lw_b=54dB$, $Lw_c=73dB$, $Lw_d=67dB$ and $Lw_d=45dB$

So, $Wb=Wox10^{54/10}$ $Wc=Wox10^{73/10}$ $Wd=Wox10^{67/10}$ $We=Wox10^{\frac{45}{10}}$

$W=Wa+Wb+Wc+Wd+We$

$=Wo(10^{6.1}+10^{5.4}+10^{7.3}+10^{6.7}+10^{4.5})$

Resultant Sound Power $Lw = 10[logWo(10^{6.1}+10^{5.4}+10^{7.3}+10^{6.7}+10^{4.5})/Wo]$

$=>Lw=74.23dB$

Equivalent Continues Noise Level

'Equivalent continues noise level(L_{Aeq})' of that steady sound which over the same interval of time contains the same total energy as the fluctuating sound.

$$L_{Aeq}=10\log_{10}\left(\frac{1}{T}\sum_{i=1}^{n}10^{0.1li}\times t_i\right)$$

Where, T=total time of Operation.
Li=Noise Level of the ith Sample.
ti=fraction of total time.
n=number of sample.

Problem

1.If an Industrial fan generates a noise level of 65 dB(A) for 10 minutes out of every hour. Compute the LAeq, if the background level is 55dB(A)?

Ans–$L_{Aeq}=10\log_{10}\left(\frac{1}{T}\sum_{i=1}^{n}10^{0.1li}\times t_i\right)$

Here, T=60,L1=65 dB(A) and L2=55dB(A) t1=10, t2=50

So, $L_{Aeq}=10log\left[\frac{1}{60}\left(10^{0.1\times65}\times10\right)+\left(10^{0.1\times55}\times50\right)\right.$

$=$ 59dB(A)

Ambient Air quality standards in respect of Noise

Area Code	Category of Area/Zone	Limits in dB(A) L_{eq}*	
		Day time	Night time
A	Industrial area	75	70
B	Commercial area	65	55
C	Residential area	55	45
D	Silence Zone	50	40

Note :-

1. *Day time shall mean from 6.00 a.m. to 10.00 p.m.*
2. *Night time shall mean from 10.00 p.m. to 6.00 a.m.*
3. *Silence zone is an area comprising not less than 100 metres around hospitals, educational institutions, courts, religious places or any other area which is declared as such by the competent authority.*
4. *Mixed categories of areas may be declared as one of the four above mentioned categories by the competent authority.*

Permissible Noise level standards for house appliances

60dB(A)

68 dB(A)

75 dB(A)

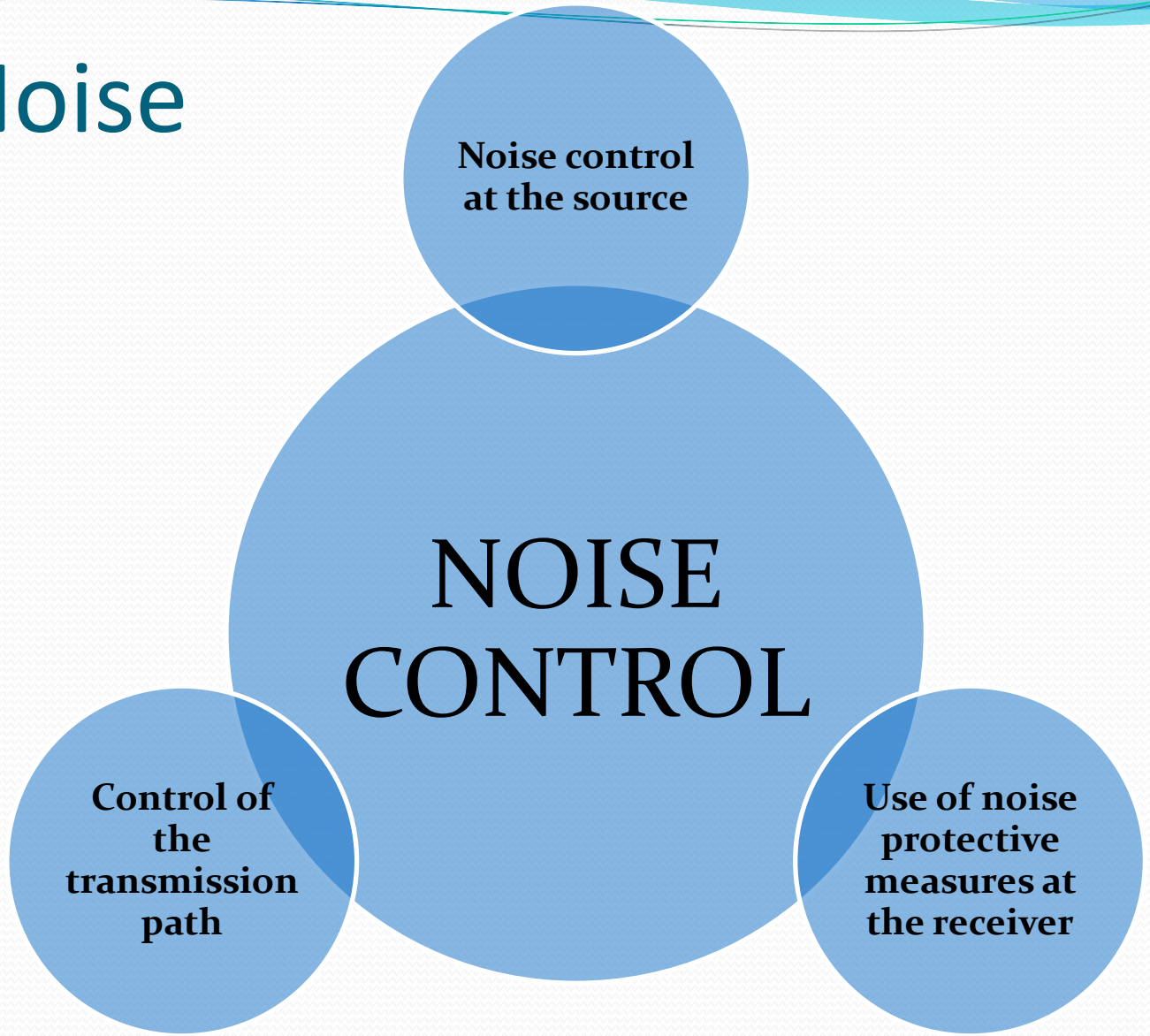
85-90 dB(A)

Impact of Noise pollution on health

Pathological Effects	Physiological Effects	Psychological Effects
Hearing loss, reduction of speech intelligibility, acoustic traumas, auditory fatigue, etc.	Changes in blood pressure, pulse rate, constriction of blood vessels, dilation of the pupil of eye and changes in blood cholesterol content, etc.	Feelings of discomfort, sleep interference, reduced intellectual performance, fatigue, vexation, irritation, distress, mental or neurological disorders, antisocial behaviour, etc.

Noise above 60dB has a negative effect on increased use of psychotropic medication.

Control of Noise



Noise Reduction at the Source

- The reduction of the exciting forces e.g., reduction of impacts or, impulsive forces, balancing of moving masses, reduction of frictional forces by proper alignment and lubrication etc.
- Application of vibration dumping materials to the radiating surfaces. Rubber plastic between to metallic body

- Changes in operating procedure, e.g., a factory, adjacent to the residential areas, suspend or reduce noise generating operations at night
- Sound generating instrument running in sound insulating room

Noise control of the transmission path

- Sitting e.g., increasing distance between source and the Receiver.
- Path deflection e.g., by use of barrier. Sound deflector tile ,
- Properly designed enclosures.
- Absorption e.g., use of sound absorbing material in a room where both the source and the receiver are present in a room.

Protective Measures at the receiver

- Use of personal protective equipment, e.g., use of earplugs, earmuffs, noise helmets etc.
- Education and public relations.
- Exposure Control. e.g., the rotation of personnel so that work assignments in the intense noise area are for a limited period of time only.


thank
you