

Sem: 3 ENVIRONMENTAL POLLUTION AND TOXICOLOGY

Module VI. Noise, Thermal and Oil Pollution

Topic: **PROPERTIES OF SOUND AND NOISE & EFFECT OF NOISE ON PEOPLE AND ECOSYSTEM**

SOUND

- Sound is defined as vibrations that travel through the air or another medium as an audible mechanical wave. It is produced from a vibrating body. The vibrating body causes the medium (water, air, etc.) around it to vibrate thus producing sound.
- Sound is created when something vibrates and sends waves of energy (vibration) into our ears.
- Sound changes depending on how fast or slow an object vibrates to make sound waves. Pitch is the quality of a sound (high or low) and depends on the speed of the vibrations.

NOISE

- Noise can be defined as "unwanted sound", and an audible acoustic energy that adversely affects the physiological and/or psychological well-being of people, or which disturbs or impairs the convenience or peace of any person.
- We can generalize by saying that sound becomes unwanted when it:
 - hinders speech communication;
 - impedes the thinking process;
 - interferes with concentration;
 - obstructs activities (work or leisure); or
 - presents a health risk due to hearing damage.

PROPERTIES OF SOUND

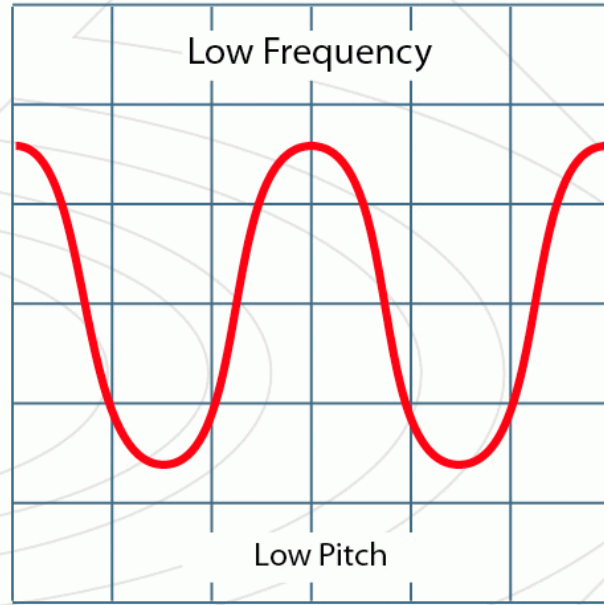
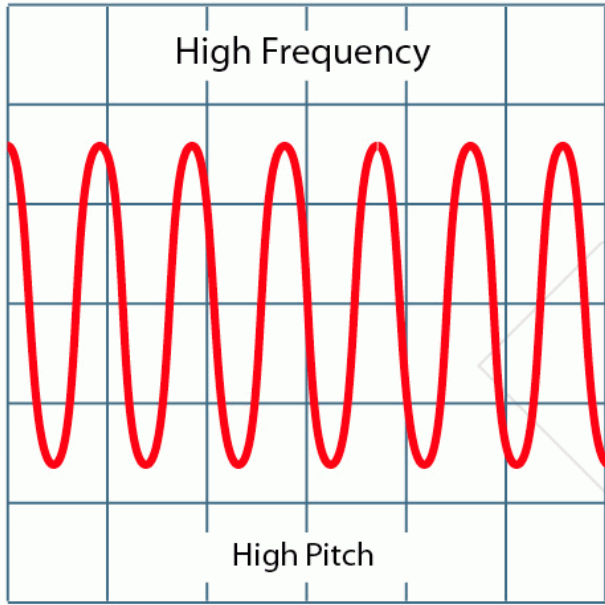
Six Basic Properties of Sound

- Frequency/Pitch
- Amplitude/Loudness
- Spectrum/Timbre
- Duration
- Envelope
- Location

➤ **Frequency/Pitch**

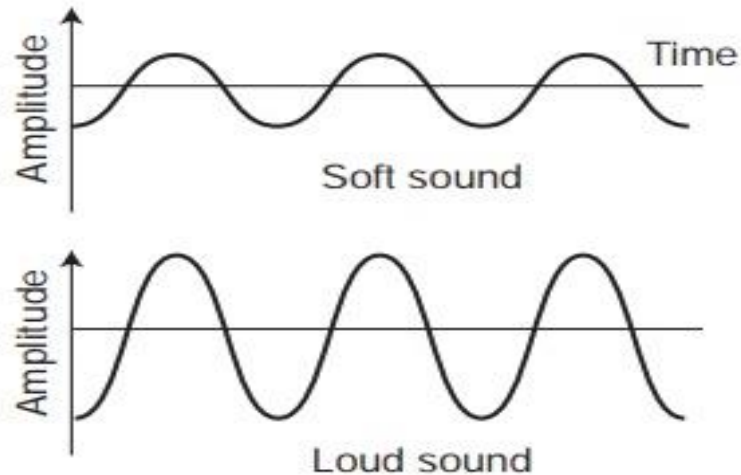
Frequency is the speed of the vibration, and this determines the pitch of the sound. Frequency is measured in Hertz (Hz). One Hz is one cycle per second. Human hearing lies within the range of 20Hz - 20,000Hz. As we get older the upper range of our hearing diminishes. Human speech generally falls in the range from 85 Hz - 1100 Hz.

Pitch is a perceptual property of sounds that allows their ordering on a frequency-related scale, or more commonly, pitch is the quality that makes it possible to judge sounds as "higher" and "lower" in the sense associated with musical melodies. Pitch can be determined only in sounds that have a frequency that is clear and stable enough to distinguish from noise.



➤ Amplitude/Loudness

Amplitude is the size of the vibration, and this determines how loud the sound is. The amplitude of a sound is a measure of its power and is measured in decibels. We perceive amplitude as loud and soft. Studies in hearing show that we perceive sounds at very low and very high frequencies as being softer than sounds in the middle frequencies, even though they have the same amplitude. While amplitude is a quantitative, physical measurement, loudness is a qualitative, perceptual measure of how loud a sound sounds.



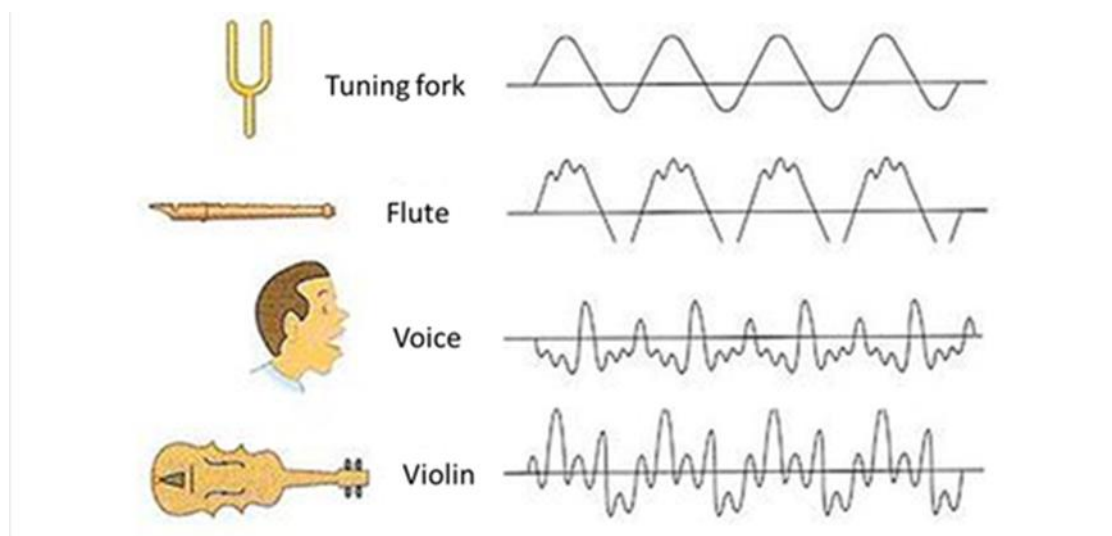
➤ Spectrum/Timbre

A sound spectrum displays the different frequencies present in a sound.

A sound spectrum is a representation of a sound – usually a short sample of a sound – in terms of the amount of vibration at each individual frequency.

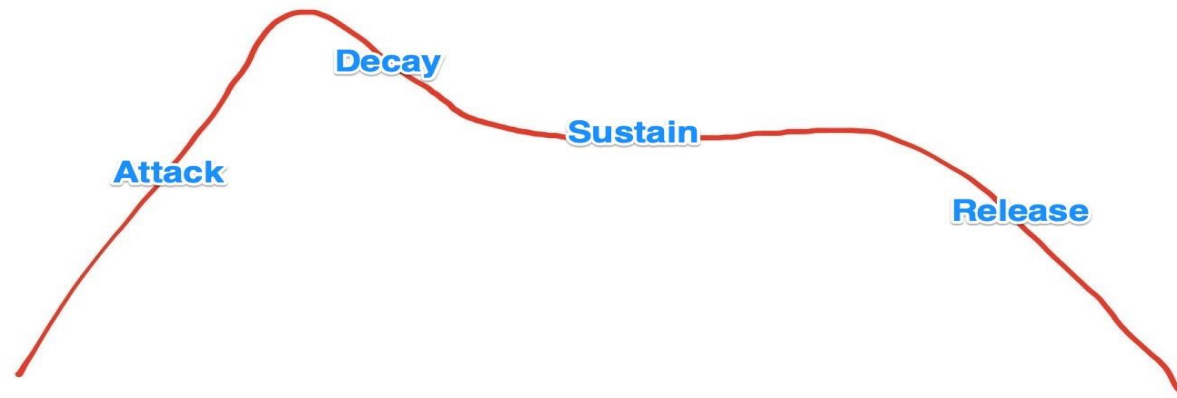


Timbre refers to the characteristic sound or tone color of an instrument. A violin has a different timbre than a piano. It's what makes a piano sound different from a flute or violin. The timbre of a musical instrument is determined by its physical construction and shape. Sounds with different timbres have different wave shapes.



➤ Envelope

The envelope is complicated and varies greatly among different sounds. In musical notes, one can sometimes identify different stages: a rapid increase in loudness, called the attack, a subsequent fall in loudness, called the decay, a period during which the loudness varies little, called the sustain, and finally a period during which the loudness falls to zero, called the release.



➤ **Duration**

Duration refers to how long a sound lasts or Duration is the length of time a pitch, or tone, is sounded.

When we talk about duration we're talking about time. We need to know two events related to the time of a sound, when did it start and how long did it last. In music and digital audio, time usually starts at zero. How time is tracked is usually a variation on chronological time or proportional time. Here are some examples.

➤ **Location**

Location describes the sound placement relative to our listening position. Location refers to the listener's perception of where the sound originated.

PROPERTIES OF NOISE

- Frequency
- sound Pressure
- sound Power
- Time Period

➤ Frequency

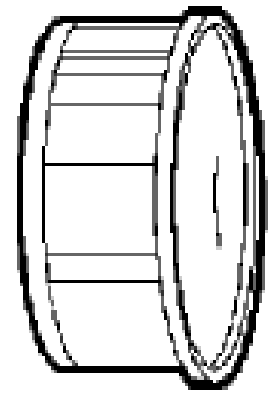
Frequency is the rate at which the source produces sound waves, i.e. complete cycles of high and low pressure regions. In other words, frequency is the number of times per second that a vibrating body completes one cycle of motion.

➤ sound pressure

Sound pressure is the amount of air pressure fluctuation a noise source creates. We "hear" or perceive sound pressure as loudness.

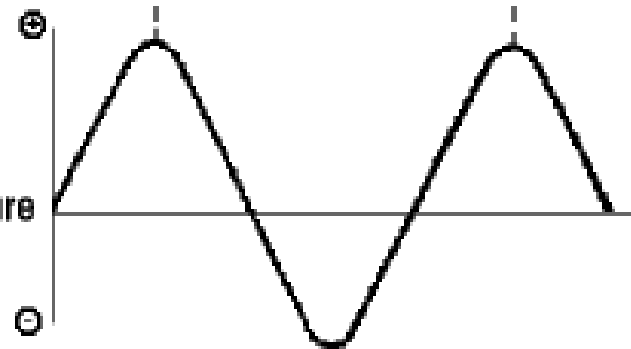
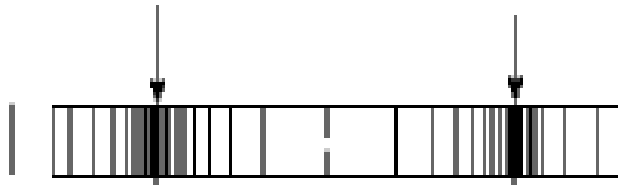
Sound pressure also depends on the environment in which the source is located and the listener's distance from the source.

GENERATION OF SOUND WAVES



Air Compression

Air Compression



Variation in Air Pressure

Distance from the Source

➤ sound power

The sound power is the sound energy transferred per second from the noise source to the air. A noise source, such as a compressor or drum, has a given, constant sound power that does not change if the source is placed in a different environment.

An average whisper generates a sound power of 0.0000001 watts , a truck horn 0.1 W, and a turbo jet engine 100,000 W.

➤ Time Period

The time required to produce one complete wave or cycle or cycle is called time-period of the wave. Now, one complete wave is produced by one full vibration of the vibrating body. So, we can say that the time taken to complete one vibration is known as time-period. It is denoted by letter T. The unit of measurement of time-period is second (s).

relation between time-period and frequency of a wave

The time required to produce one complete wave is called time-period of the wave. Suppose the time-period of a wave is T seconds.

In T seconds number of waves produced = 1

So, in 1 second, number of waves produced will be = $1/T$

But the number of waves produced in 1 second is called its frequency.

Therefore, $F = 1/\text{Time-period}$

$$f = 1/T$$

where f = frequency of the wave

T = time-period of the wave

- Noise pollution affects many things and is everywhere nowadays.
- Loud music in churches, vehicles on the road, airplanes flying above homes, construction machines in the neighborhood, and industries in urban areas.
- Noise within your home including the TV, blending machine, washing machine, lawn mower, etc.
- The Decibel is the unit of measure for the intensity of sound waves
- Noises that exceed 80 decibels are detrimental to health. Children are affected by noises above 60 decibels.

EFFECT OF NOISE ON PEOPLE

➤ **Damaged brain and hearing power**

- High-intensity sound waves cause unnecessary ripples in the ear canal, disturbing the fluid that aid communications between the ear and the brain. This disturbance destroys the tiny, very delicate, hair follicles that send signals to the brain whenever sounds enter the ear.
- Research has also shown that uncontrolled exposure to high-intensity noises can seriously jeopardies a kid's memory and reading power.

➤ **Increased risk of cardiovascular diseases**

- Being exposed to noise pollution for ten consecutive years or more raises your chances of suffering from at least one cardiovascular disease later in life by 300%.

- high noise levels increase an individual's pulse rates and cause constriction of blood vessels, thus making him/her vulnerable to heart attacks or high blood pressure. Being exposed to such noises for more than 8 hours a day could even be worse.

➤ **Psychological disorders**

- Research shows that too much noise makes people easily irritable, nervousness, irrational in decision making, and constant unease throughout the day.
- In extreme cases, noises can make our life so stressful that can make us socially aloof, unproductive at work due to poor concentration, and emotional instability due to reduced self-confidence.

➤ **Difficulty in sleeping**

- Noise can deter sleep because of its psychological effect. Having noise around can distort peaceful sleep as it causes stress.
- being in a noisy place means there is almost no chance of having any sleep.
- Inadequacy of sleep in turn interrupts the normal functioning of the body, leading to discomfort, fatigue, and general moodiness.

➤ **Emotion and behavioral change**

- Too much noise means disturbance of peace which may lead to annoyance or anger.
- People in this state tend to have constant headaches which may even intensify if the noise is continuous.

- This may lead to an amplified stress levels and thus, emotions take over and violence may ensue.
- With such behavior, it becomes hard to concentrate on work and achieve set goals owing to reduced work efficiency.

EFFECT OF NOISE ON ECOSYSTEM

- Most animals are incredibly sensitive to noise and flee when something is too loud for their liking.
- Almost all wild animals have a survival instinct to run away when they hear something unfamiliar.
- To avoid noisy areas, animals change their behaviors. This can impact the predator-prey relationships in an area and change how plants are pollinated.
- Insects can also be disrupted by it. Insects are a foundational part of any ecosystem, and, if their habits and behaviors are changed because of noise pollution, it can set off a chain reaction for the rest of the ecosystem.

- This can lead to a reduction of certain species or an increase in others. In either case, if an imbalance occurs, it disrupts the natural order of an area.
- Noise pollution can even have an impact on humans who travel into nature to get away from the stresses of life. It can be hard to relax and enjoy natural sounds if you're being bombarded by noise from vehicles, airplanes or mining equipment.



THANK YOU