

Audio and Video Media

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Characteristics of Sound

- Sound is a longitudinal motion consisting of a train of compressions and rarefactions travelling in a medium
- Sound waves produce variations of pressure in the medium (represented in micro-bar). These variations are compressions and rarefactions
- When sound waves strike the ear-drum, these are converted into electrical signals. The auditory nerves carry these signals to the brain which interprets them into sound



Amplitude: It is the intensity of compressions and rarefactions produced in the medium.

- Greater the intensity of sound, greater will be the compression and rarefaction

- **Frequency (f):** the number of successive compressions and rarefactions occurring in one second. 16 Hz to 20000 Hz for sound

- **Time period:** Time (T) taken to completing one cycle

$$T = 1 / f \text{ second}$$

- **Phase:** it indicates the state of motion at a particular instant relative to some reference. It is expressed in terms of angle

- **Velocity:** distance travelled in one second

- **Wavelength (λ):** the length of space covered in by one cycle of variation (expressed in metres)

- Relationship between frequency, wavelength and velocity

- $v = \text{distance} / \text{time} = \lambda / T = f\lambda$



Intensity of sound waves (in terms of energy)

- It is defined as the average rate of flow sound energy .
- It is proportional to the square of amplitude
- Intensity of sound is indicated in decibels (dB)

Audible sound (Threshold of hearing):

- Human ear can detect sound intensity as low as 0.1 pW/m^2 .
- It is sensitive to the ratios of intensity.
- It can't distinguish two sounds of intensity variation less than 1 dB.
- Comfortable detection level is 3 dB over the threshold of hearing for speech and music



Noise

Unwanted sound present in the environment or coming out of the loudspeaker.

Noise consists of pressure variations of random nature, without continuity and any regularity of frequency, shape, and amplitude.

- Environmental Noise
- Electrical Noise



Environmental noise

- Transients (sounds which occur suddenly for short duration)
E.g. thunder, explosions
- Ambient noise: recording studio
- SNR should be more than 50 dB
- External noise transmitted through solid structures can be reduced by using double wall technique with air between the walls
- Proper placement of microphones and use of directive microphones will prevent environmental noise from entering into the audio system



Harmful effects of noisy environment

- It strains the nervous system
- It causes mental fatigue
- It irritates workers and lowers their efficiency
- Vary loud and sudden noise may impair hearing
- It retards the normal growth of infants and young children

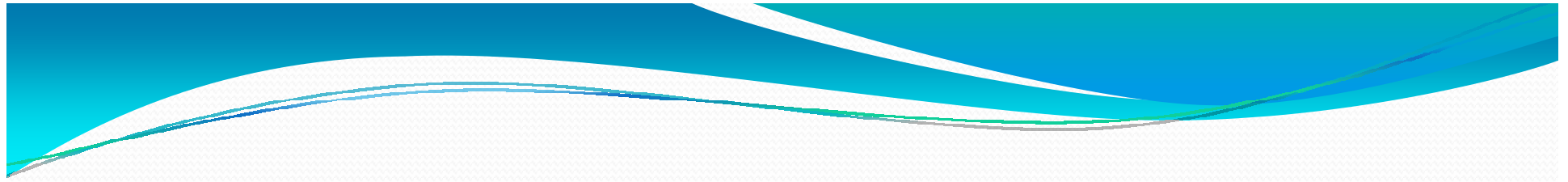


Electrical Noise

- Noise caused by random motion of electrons in components, reception of unwanted signals, random variation of magnetism (in tape), and groove irregularities in discs.

Different types

- Noise produced by diodes, transistors, components: Noise (called johnson noise or white noise) produced in a resistance due to random motion of electrons.
- Self noise is also produced by diodes and transistors
- All these noise combine and produce hissing noise in loudspeaker and snow in picture tube
- Noise produced by sparks and RF transmissions: An electrical spark results in emission of RF signals which give rise to noise
- Man-made transmissions at RF frequencies other than desired one also cause inter-modulation noise



- **Hum noise**: it is produced by ripples in the power supply or when a.c power lines run close and parallel to the input leads

Noise produced by unwanted coupling between two circuits: the coupling between two different channels gives rise to ‘cross talk’

Noise produced by transport mechanism of sound recording and reproducing devices: slow variations in speed of transport mechanisms of disc and tape recorders give rise to noises called **wow and flutter**.
Body vibrations of motors result in noise called **rumble**

Noise produced by random variations of magnetism – hissing noise

Noise produced by irregularities in the disc grooves

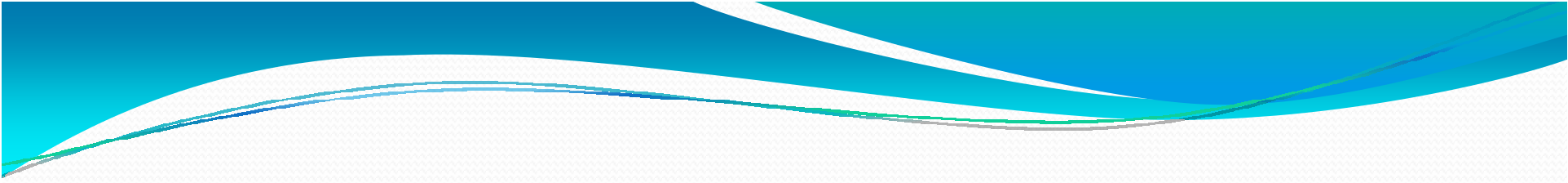


Noise Reduction Techniques

- **Environmental noise** can be reduced by using proper insulation, absorption materials in the hall, proper acoustic design, and placement of microphones and loudspeakers

Electrical noise can be reduced by

- Use of active components
- Proper shielding and grounding to prevent undesired coupling, and hence self oscillation
- Adequate decoupling of circuits to prevent self oscillation
- Use of trap circuits to bypass RF interface
- Stabilised power supply with little ripple
- Mechanical filtering of body vibrations of motors used in recording systems
- Use of synchronous and servo-controlled motor for steadiness of speed
- Reduction of friction by proper oiling

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- Proper maintenance of heads in magnetic recording and playback
 - Care in recording grooves, so that roughness is minimum
 - Smooth high quality coating of magnetic material on tape
 - Use of special circuit technique (Dolby) for improving SNR



thank
you



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