LECTURE 11

I. Sound Waves

Definition

Vibrations created by moving air.

Formation

- When an object vibrates, surrounding air molecules rapidly **condense** (compress) and **rarefy** (pull apart).
- These fluctuations generate a sound wave that travels away from the object.

Characteristics

- Composed of areas of compressed air and rarefied air.
- Travels at approximately **700 mph**.

II. Audition (Hearing)

The human ear **transduces** (converts) fluctuations in air pressure into neural signals.

Range of Human Hearing

- Sound waves are generated by vibrations between **20 and 20,000 vibrations per second (Hz)**.
- This range corresponds to wavelengths roughly between *17 millimeters and 17 meters*.

Wavelength Relationship

- **Faster vibrations** = Smaller wavelengths.
- **Slower vibrations** = Longer wavelengths.

III. Three Physical Dimensions of Sound

1. Loudness (Amplitude / Intensity)

> **Definition:** The amplitude or intensity of molecular vibrations.

- **Explanation:** Represents the relative difference in the density of air molecules between compressed and rarefied air.
- **Perception:** How "loud" or "soft" a sound is perceived.
- **Dimension:** Relates to how far the sound travels.

> *Visualized as a tall wave (LOUD) vs. a short wave (SOFT).*

2. Pitch (Tone / Frequency)

> **Definition:** The frequency of molecular vibrations.

- **Measurement:** Measured in **Hertz (Hz)**, which represents cycles per second.
- **Explanation:** The distance between the peaks of compressed air in a sound wave.
- **Relationship:** Every frequency corresponds to a specific wavelength.
- **Perception:** Determines if a sound is perceived as "high" or "low" (e.g., impacts where a bend in the cochlea occurs).

> *Visualized as closely spaced waves (HIGH) vs. widely spaced waves (LOW).*

3. Timbre (Complexity)

> **Definition:** The complexity of a sound wave.

- **Purpose:** The brain processes this complexity to determine the source of a sound.
- **Mechanism:** A distinguishing property related to how the sound wave is distorted or modified from a simple sine wave.

> *Example: Differentiating between musical instruments playing the same note.*