1. Sound

- Sound is a form of energy that travels in waves and is produced by vibrating objects.
- Sound needs a medium (solid, liquid, or gas) to travel and cannot travel through a vacuum.

1.1 Production of Sound

- **Vibration and Sound:** Sound is produced when objects vibrate. These vibrations create sound waves that travel through a medium to reach our ears.
- **Examples of Vibrations Producing Sound:**
  - **String Instruments:** Strings vibrate (e.g., guitar, violin).
  - **Wind Instruments:** Air columns vibrate (e.g., flute, trumpet).
  - **Percussion Instruments:** Membranes or surfaces vibrate (e.g., drums, tabla).

1.2 Sound Propagation and Mediums

- **Sound Waves and Mediums:** Sound travels as a longitudinal wave, where particles of the medium vibrate back and forth in the direction of wave travel.
- **Propagation in Different Mediums:**
  - **Solids:** Sound travels fastest due to closely packed particles.
  - **Liquids:** Sound travels slower than in solids but faster than in gases.
  - **Gases:** Sound travels slowest due to widely spaced particles.

1.3 Characteristics of Sound

- **Frequency:** Number of vibrations per second, measured in Hertz (Hz).
  - **Pitch:** Higher frequency means higher pitch, and lower frequency means lower pitch.
- **Amplitude:** The maximum displacement of vibrating particles, affecting the loudness.
  - **Loudness:** Higher amplitude means louder sound; lower amplitude means softer sound.
- **Time Period:** The time taken for one complete vibration (in seconds).
  - **Relationship with Frequency:** Frequency = $\frac{1}{Time\ period}$

1.4 Audible and Inaudible Sounds

- **Audible Sounds:** Sounds with frequencies between 20 Hz and 20,000 Hz, which humans can hear.
- **Inaudible Sounds:**
  - **Infrasonic Sound:** Frequencies below 20 Hz (e.g., seismic waves).
  - **Ultrasonic Sound:** Frequencies above 20,000 Hz (e.g., used in medical imaging).

Ultrasound in Medicine: Used for imaging internal organs, monitoring pregnancies, and detecting tumors.

1.6 Human Ear and Hearing Mechanism

- **Structure of the Ear:**
  - **Outer Ear:** Collects sound waves and directs them through the ear canal.
  - **Middle Ear:** Contains three bones (hammer, anvil, and stirrup) that amplify vibrations.
  - **Inner Ear:** The cochlea converts vibrations into electrical signals sent to the brain via the auditory nerve.
- **Working of the Ear:**
  - Sound waves travel through the ear canal and vibrate the eardrum. These vibrations are amplified by the middle ear bones and sent to the cochlea in the inner ear. The cochlea converts them into electrical signals for the brain to interpret.

1.7 Sound Pollution

- Sound pollution, or noise pollution, is the presence of unwanted, excessive sound that can harm human health.
- **Sources of Noise Pollution:**
  - **Natural Sources:** Thunderstorms, volcanic eruptions.
  - **Human-Made Sources:** Traffic, industrial machinery, loudspeakers, construction activities.

1.8 Harmful Effects of Noise Pollution:

- Causes stress, hearing loss, sleep disturbances, and high blood pressure.

Methods to Reduce Noise Pollution:

- Planting trees to absorb sound.
- Using soundproof materials in buildings.
- Limiting the use of loudspeakers and horns.