Al-Mustaqbal University Colleg
Medical Physics Department

General Physics/ lecture 8

First stage

Dr. Nasma Adnan
Dr. Aiyah Sabah
M. Sc. Mohammed Saleh
M. Sc. Sara Jaleel

2021-2022

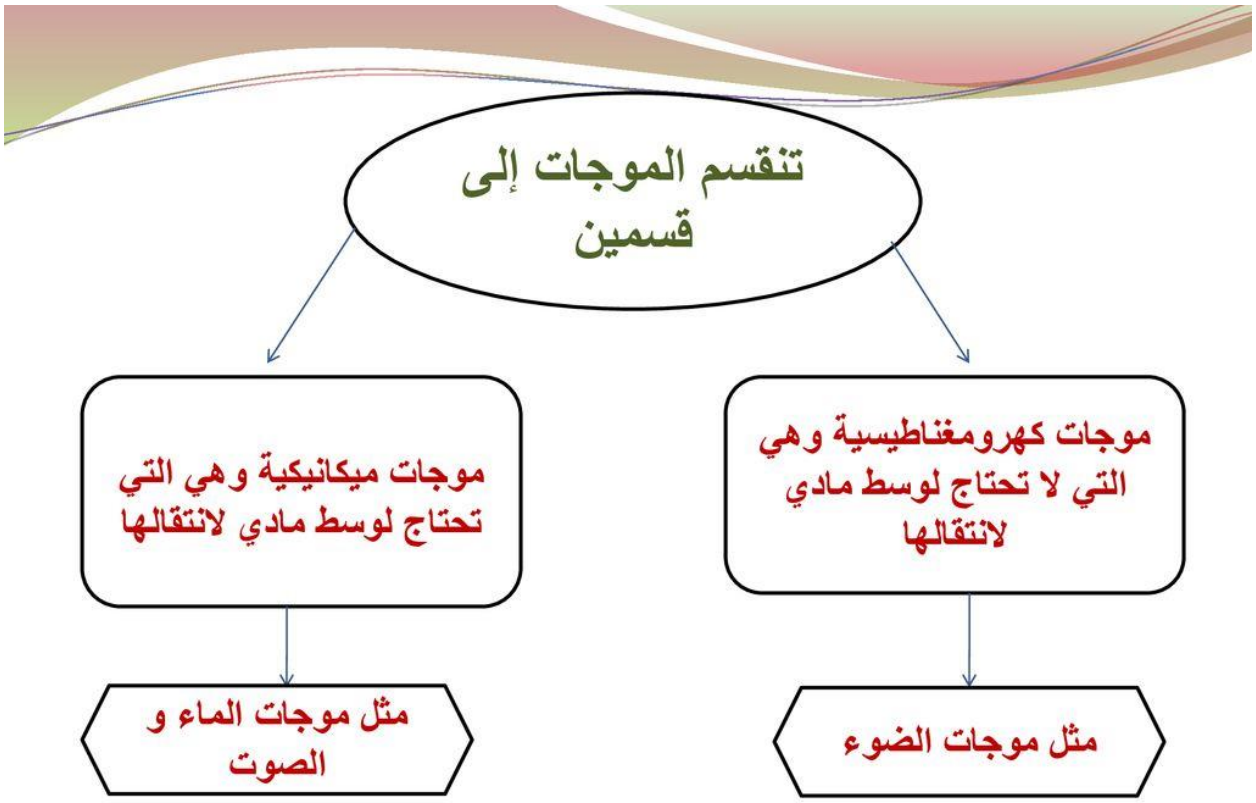
Lecture 8

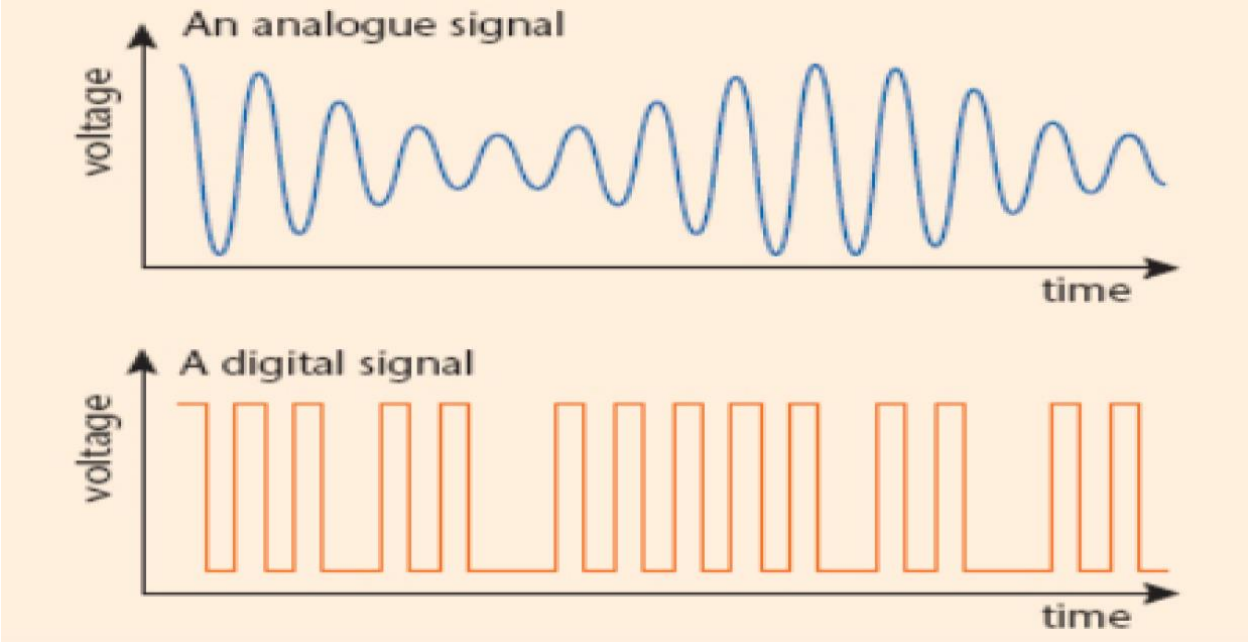
Outline

- **Waves**
- **Sound**
- **Sound velocity**
- **sound intensity.**

Waves

✓ In physics, mathematics, and related fields, a wave is a propagating dynamic disturbance of one or more quantities. Waves can be periodic, in which case those quantities oscillate repeatedly about an equilibrium value at some frequency.





waves, all of them can be characterized by the following four characteristics: amplitude, wavelength, frequency, and speed. The amplitude of a wave can be described as the maximum distance the molecules are displaced from their starting place.

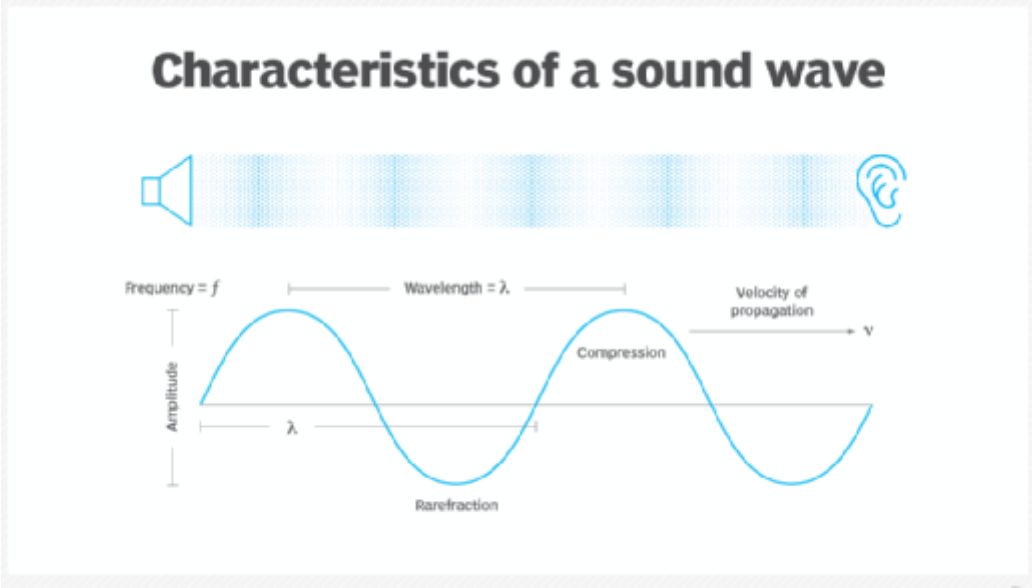
Sound

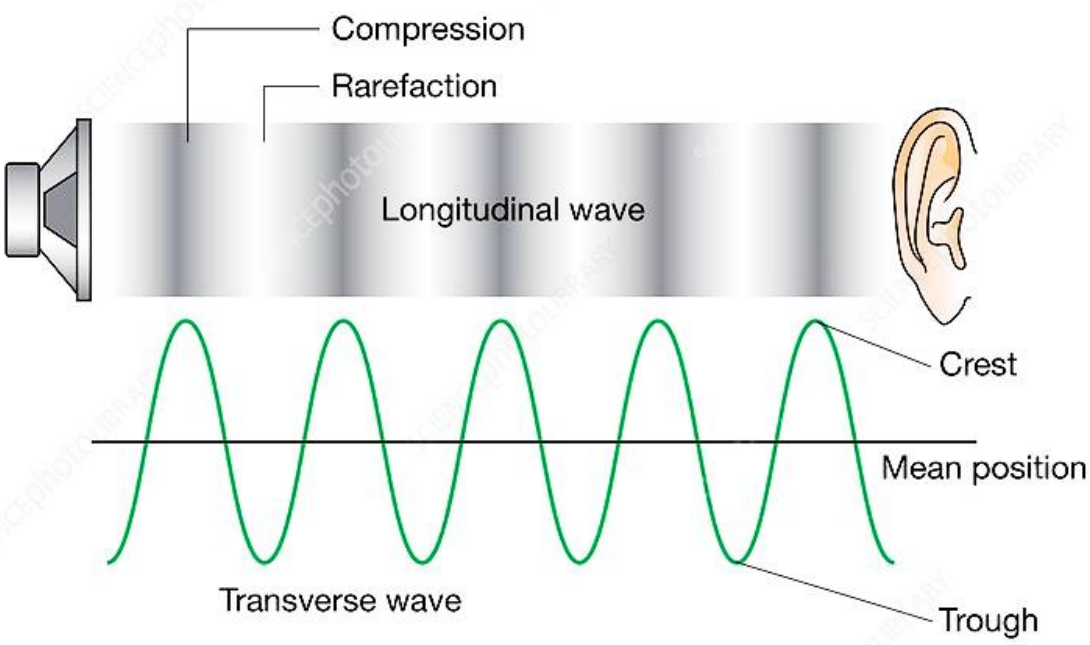
A sound wave is the pattern of disturbance caused by the movement of energy traveling through a medium (such as air, water or any other liquid or solid matter) as it propagates away from the source of the sound. Sound waves are created by object vibrations and produce pressure waves, for example, a ringing cellphone. Sound waves in air (and any fluid medium) are longitudinal waves because particles of the medium through which the sound is transported vibrate parallel to the direction that the sound wave moves. There are four main parts to a sound wave: wavelength, period, amplitude, and frequency. The three types of sound are:

Infrasonic: It is a sound with a frequency of less than 20Hz. Elephants use Infrasonic sounds to interact with herds hundreds of km away.

Sonic: It is a sound with the frequency between 20 to 20,000Hz. ...

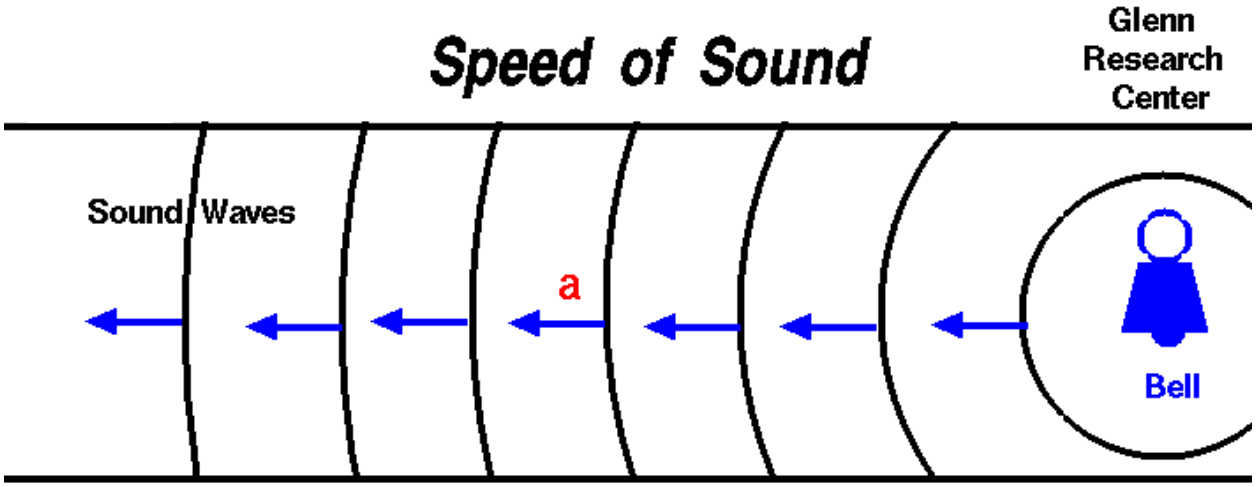
Ultrasonic: It is a sound with a frequency more than 20,000Hz.





Sound velocity

The sound velocity through a given material is the distance that sound energy will propagate in that material in a given time and is a function of material density, material's acoustic impedance, and its temperature. Because sound velocities are relatively high, most expressions are in meters or feet per second.



Speed of sound (a) depends on the type of medium and the temperature of the medium.

For calorically perfect air: γ_{perf} = ratio of specific heats = constant = 1.4

$$a^2 = R\ T\ \gamma_{perf}$$

For calorically imperfect air: γ = ratio of specific heats = $\gamma(T)$

$$a^2 = R\ T \left\{ 1 + \frac{(\gamma_{perf} - 1)}{1 + (\gamma_{perf} - 1)\left[\left(\frac{\Theta}{T}\right)^2 \frac{e^{\Theta/T}}{(e^{\Theta/T} - 1)^2} \right]} \right\}$$

$\Theta = 3056\ ^{o}K$

R = gas constant (286 $m^2/s^2/K^o$ for air) T = absolute temperature ^{o}K

sound intensity

Sound intensity, also known as acoustic intensity, is defined as the power carried by sound waves per unit area in a direction perpendicular to that area. The SI unit of intensity, which includes sound intensity, is the watt per square meter (W/m2).