UNIT IV

SUPERPOSITION OF WAVES

Applied Physics I
B.Sc.(Home Science)Semester III

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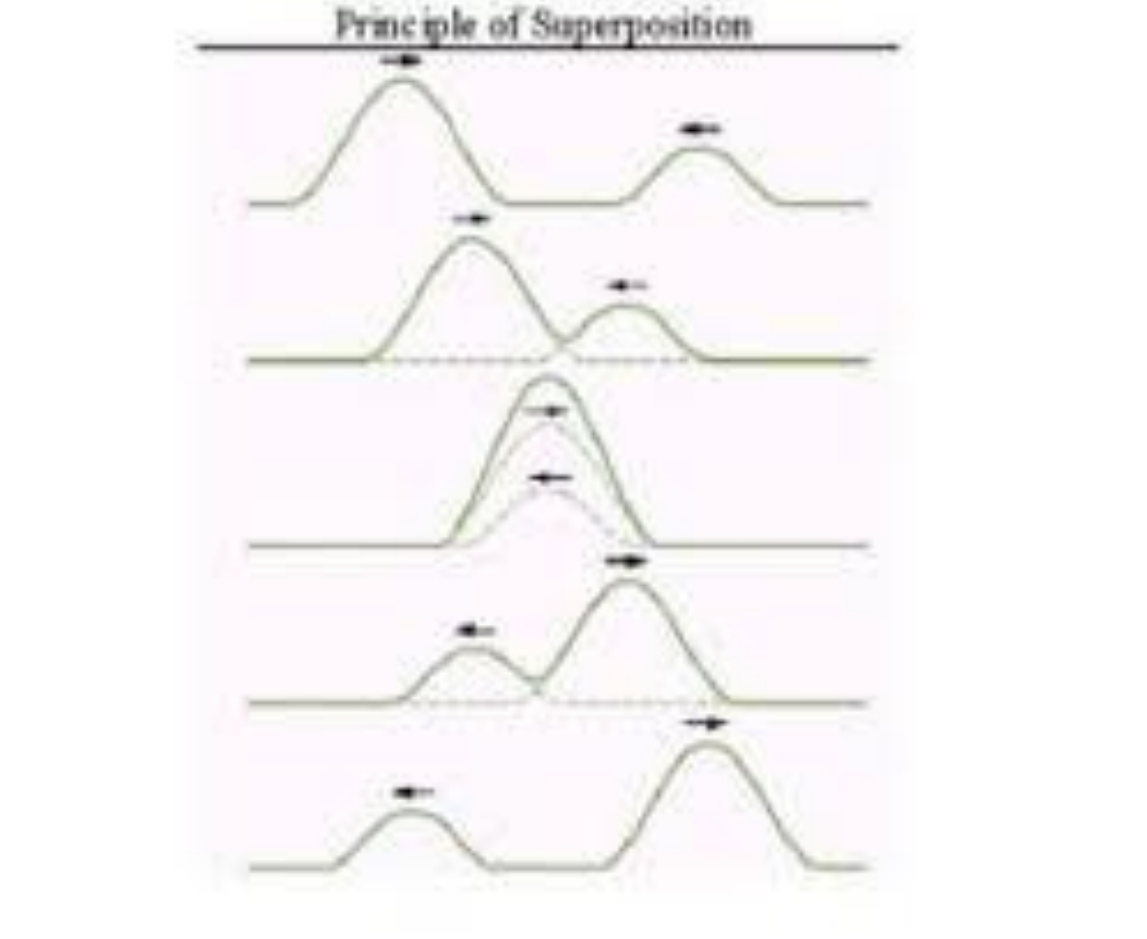
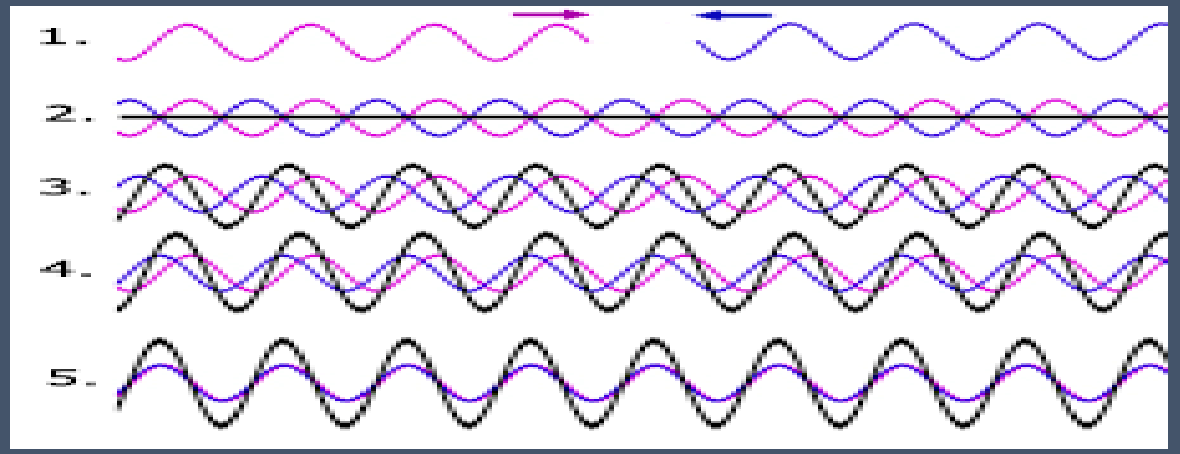
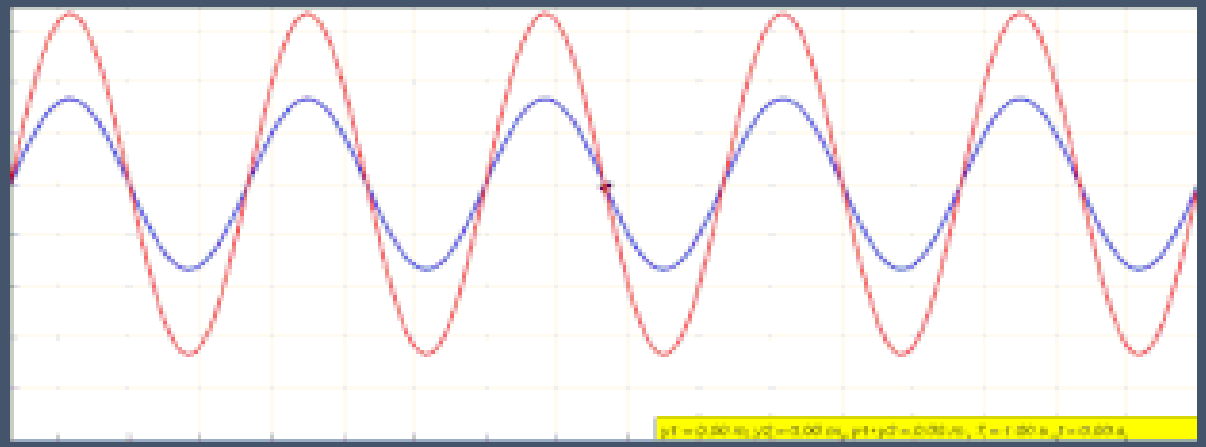
Superposition Of Waves

The phenomena of intermixing of two or more waves to produce a new wave , is called superposition of waves.







Superposition Principle

The superposition principle states that the resultant displacement of a particle is equal to the vector sum of the individual displacements given to it by the superposing waves.

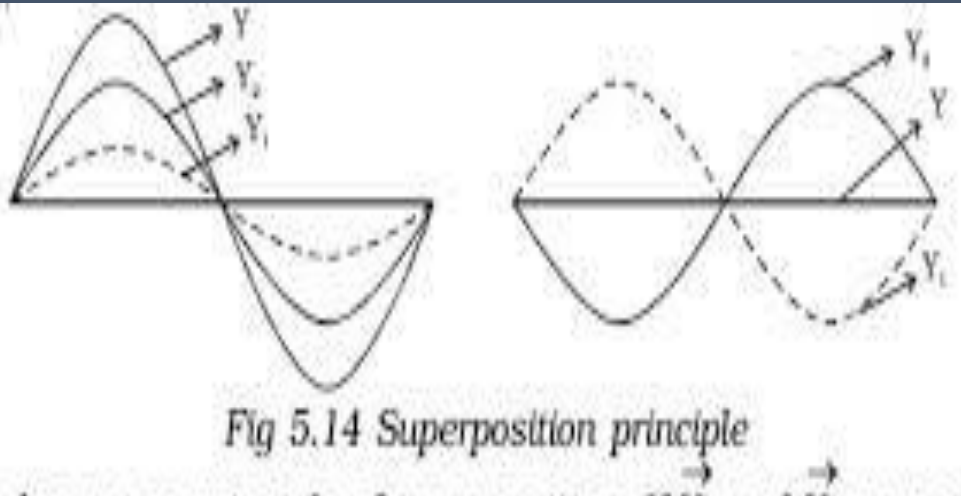


Fig 5.14 Superposition principle

This is known as principle of superposition. If $\vec{Y}_1$ and $\vec{Y}_2$ represent the individual displacement then the resultant displacement is given by

$$\vec{Y} = \vec{Y}_1 + \vec{Y}_2$$

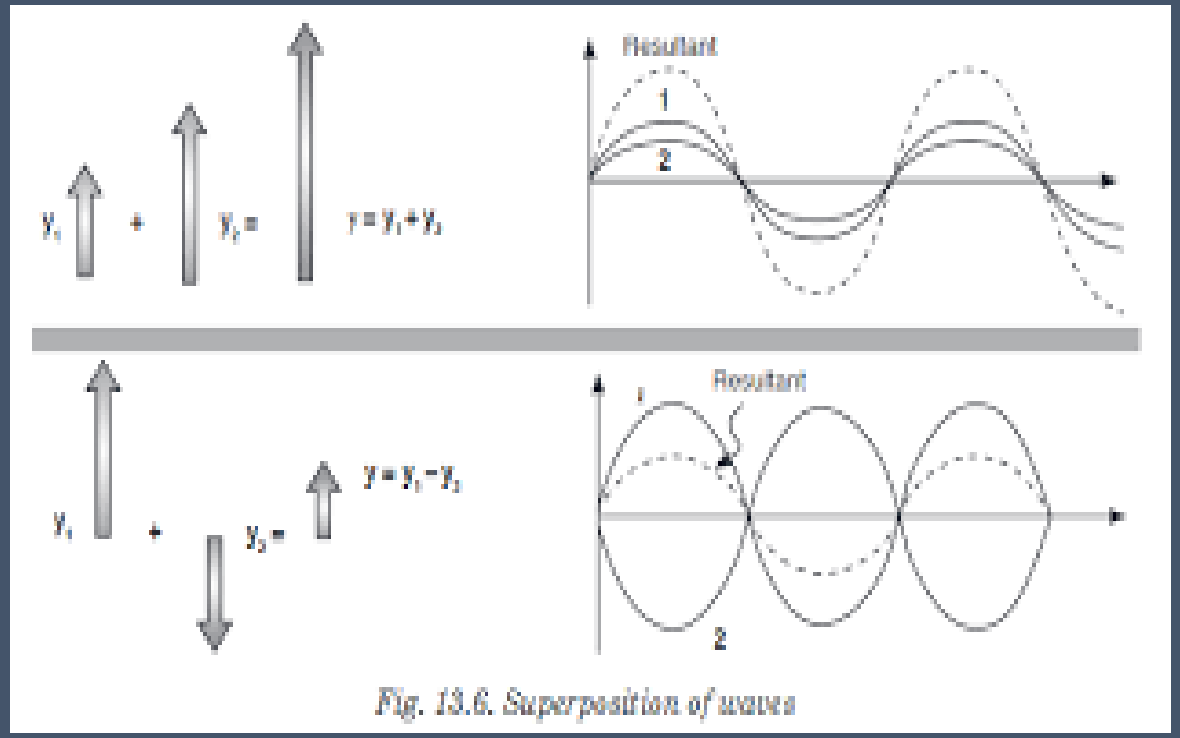
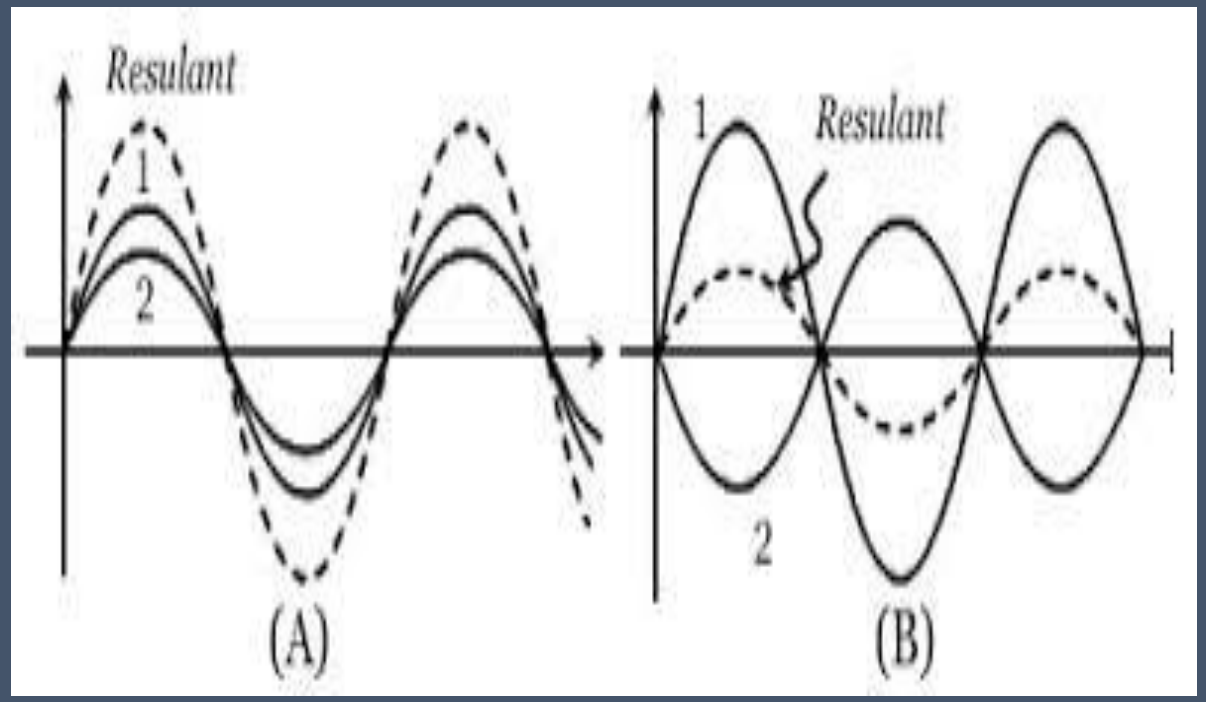
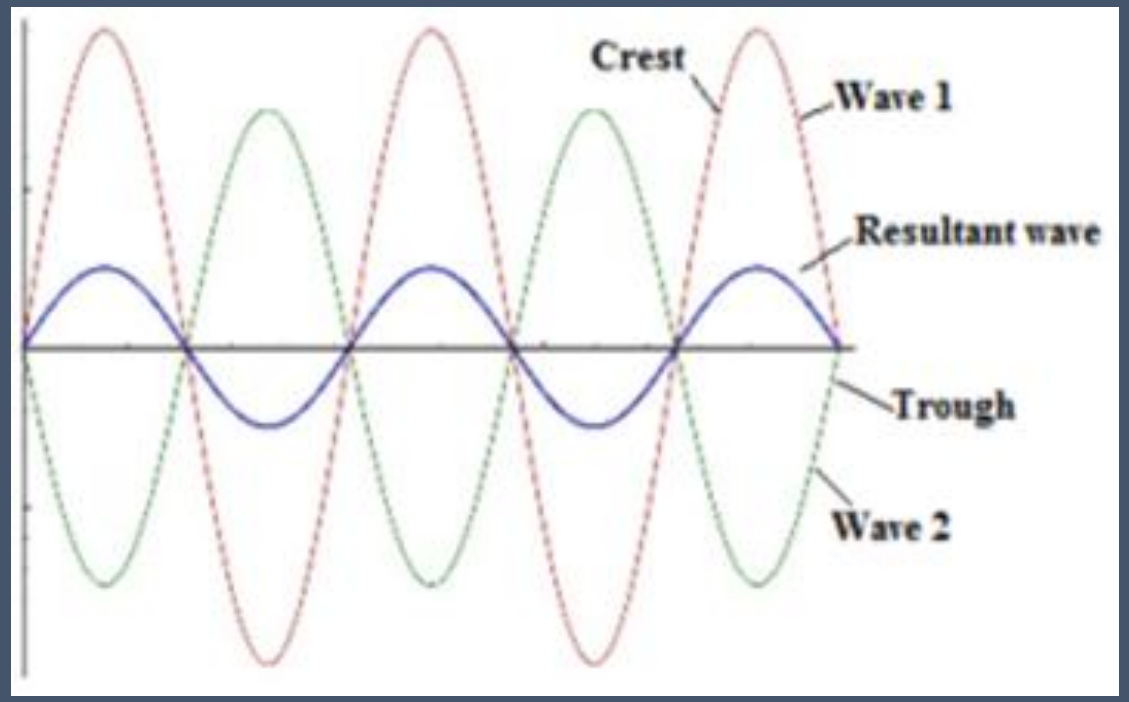


Fig. 13.6. Superposition of waves

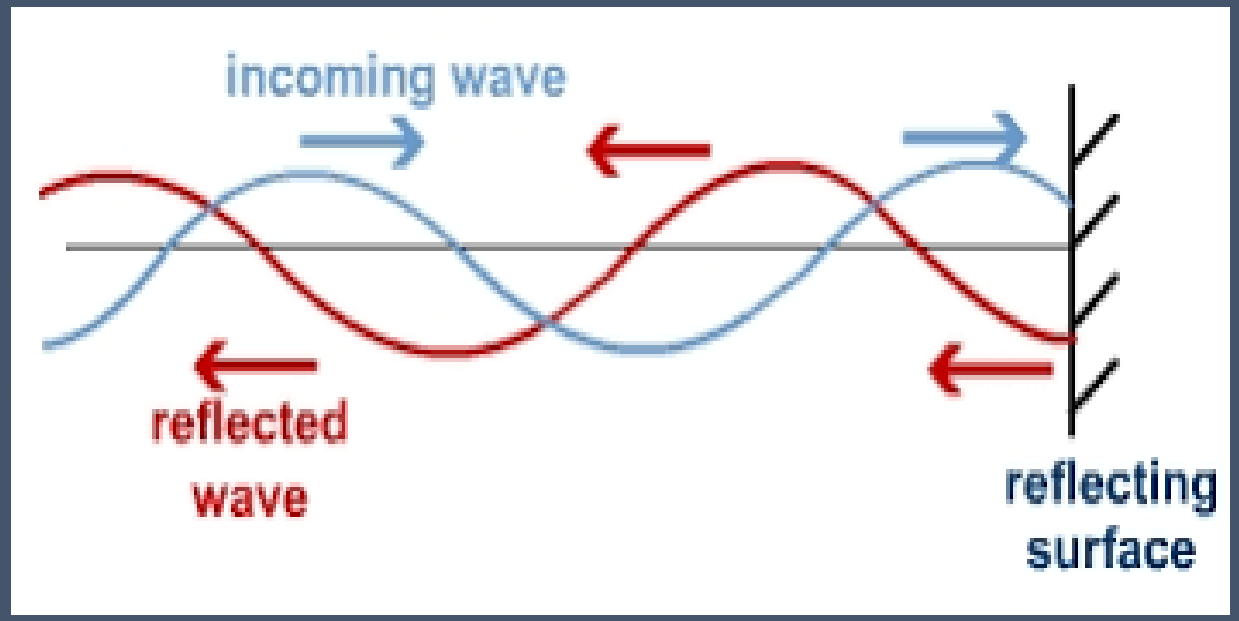


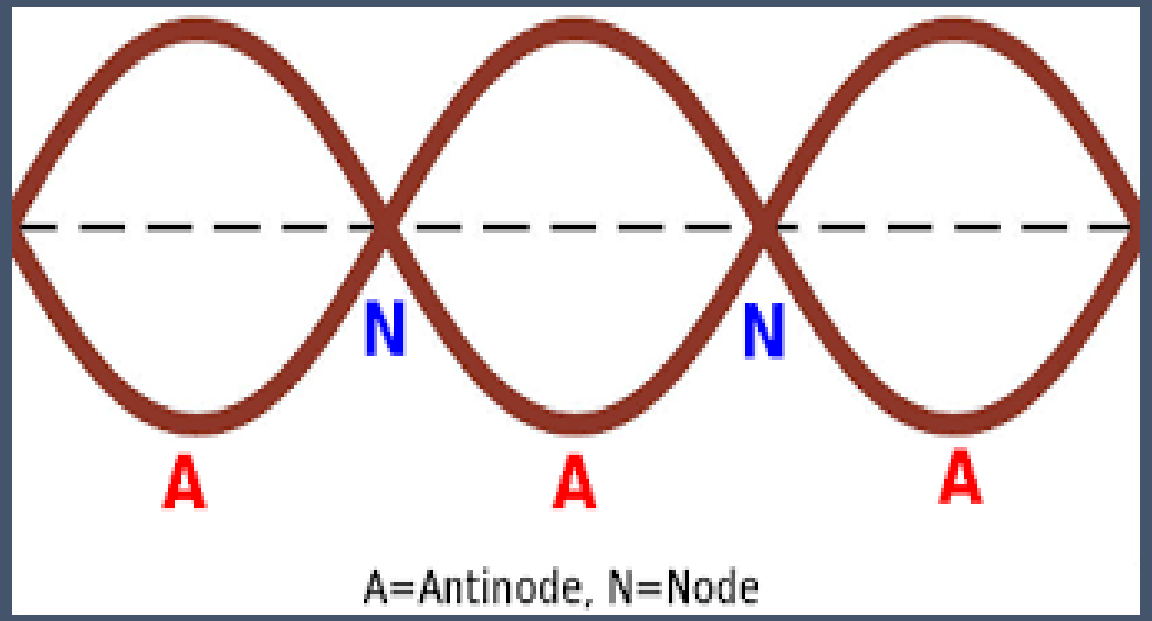


When two or more waves arrive simultaneously in a certain region of a medium the particles of the medium are subjected to two or more simultaneous displacements, one due to each wave. The resultant displacement is the vector sum of all the displacements(because displacement is a vector) and a new wave is produced.

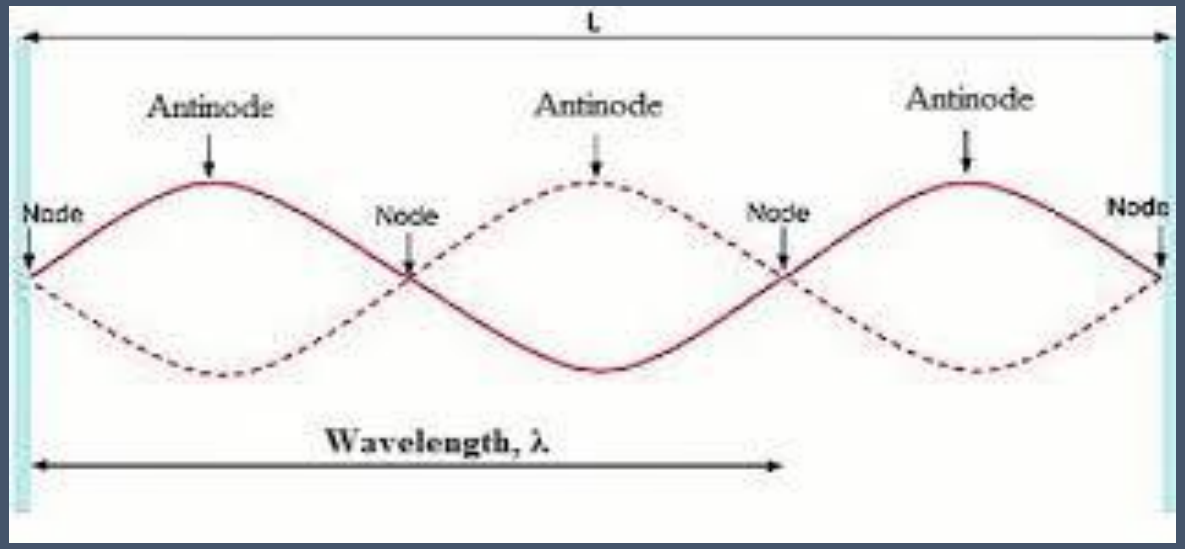
Stationary Waves

- Superposition of two waves of same frequency and same amplitude and travelling with same velocity in opposite direction , produces Stationary waves.
- Such situation arises when a wave is reflected to travel back and is superposed with incident wave.





- In some regions, particles of the medium have zero displacement and maximum strain. These regions are called **Nodes**. They are denoted by **N** .
- In some other regions, particles of the medium have maximum displacement and zero strain. These regions are called **Antinodes**. They are denoted by **A**. they are situated between nodes.



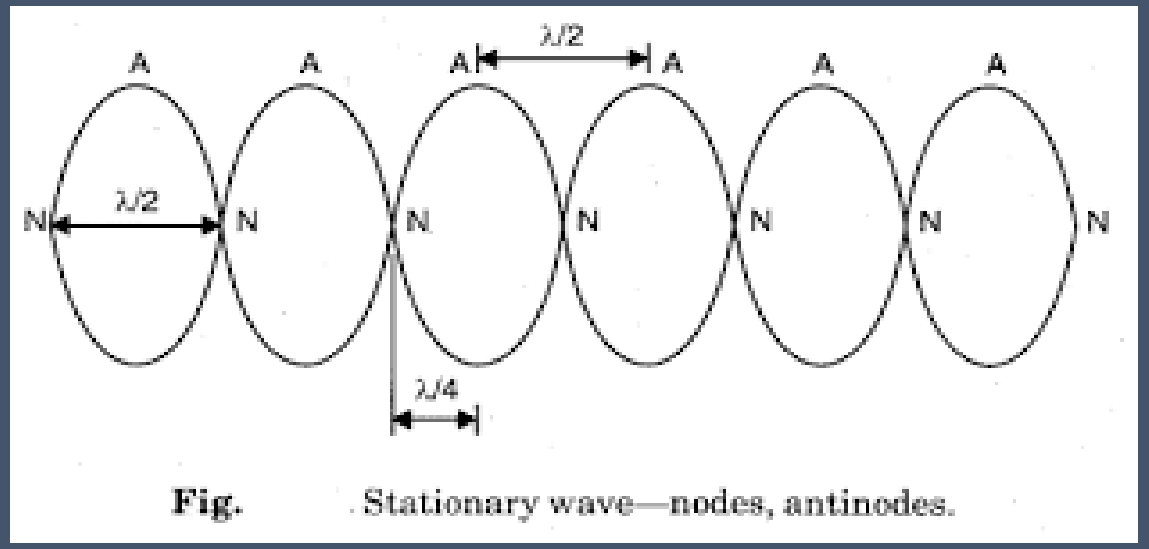
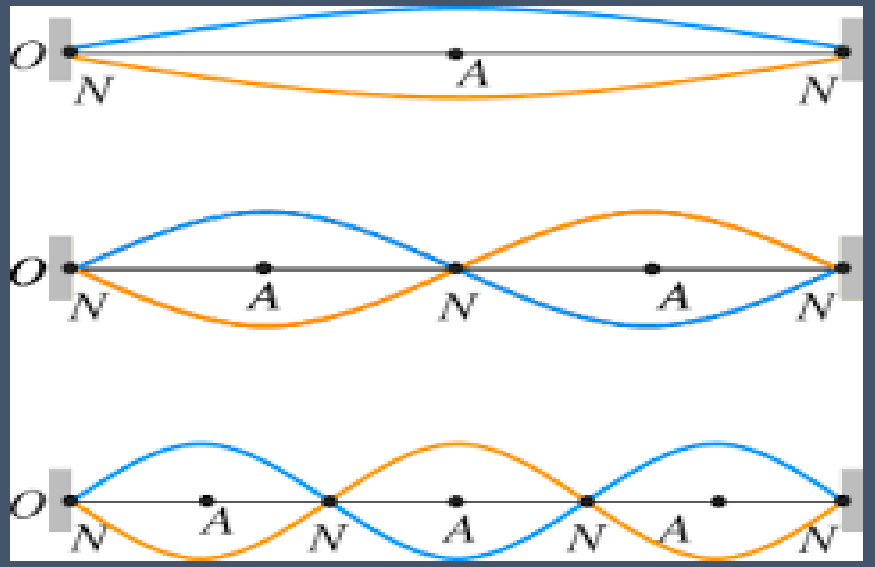


Fig. Stationary wave—nodes, antinodes.

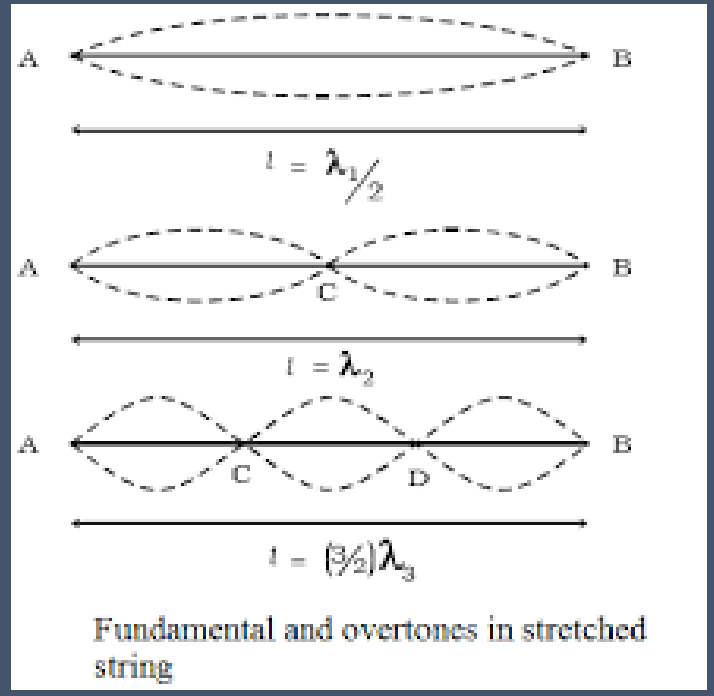
Production of Transverse Stationary Waves in Stretched String

- Let a string be fixed at its ends. On plucking it in the middle, a disturbance is produced.
- When the string is left, it moves downward and disturbances move towards the ends.
- These disturbances are reflected from the fixed ends and travel back inn the string.



- Along the string, incident and reflected waves(disturbances) get superposed.
- This superposition produces stationary waves in the string, which are transverse in nature.
- Nodes are produced at the fixed ends, where displacement is zero and strain is maximum.
- Antinode is produced in the middle (where the string is plucked) ; displacement is maximum and strain is zero.

- If the string is held at C and plucked at the middle point of C & B and then left, it vibrates in two segments.
- Similarly it can be made to vibrate in three segments and so on.
- Adjoining figures represent different modes of vibration of a string.
- When the string vibrates in one segment, the frequency is called Fundamental frequency or first harmonic ; and the mode of vibration is called Fundamental or first mode of vibration .
- When the string vibrates in two segments, it is called First overtone or second harmonic ; and the mode of vibration is called Second mode of vibration .
- When the string vibrates in three segments, it is called Second overtone or Third harmonic ; and the mode of vibration is called Third mode of vibration .



Fundamental and overtones in stretched string