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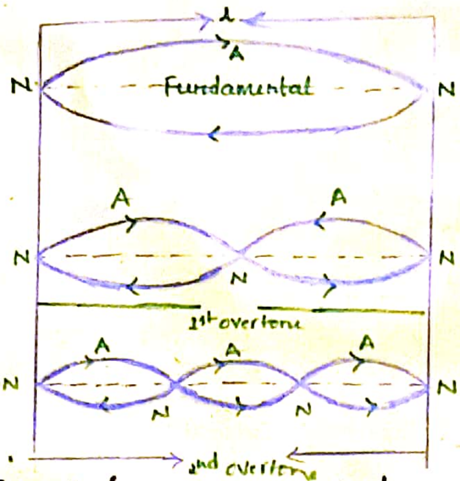
Modes of vibration of stretched string



In sitar or Guitar, a stretched string can vibrate in different frequencies and form stationery waves. This mode of vibrations are known as harmonics

In first mode of vibration, $p = 1$ then
$\nu = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$ (1st harmonic)

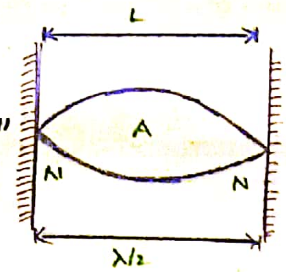
In second mode of vibration, $p = 2$ then
$\nu_1 = \frac{2}{2l}\sqrt{\frac{T}{\mu}} = 2\nu$ (2nd harmonic & first overtone)

In third mode of vibration, $p = 3$, then
$\nu_2 = \frac{3}{2l}\sqrt{\frac{T}{\mu}} = 3\nu$ (3rd harmonic & Second overtone)

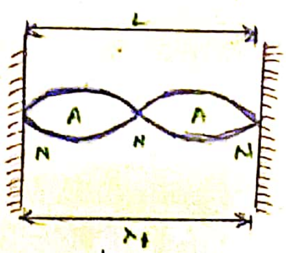
Ratio of frequency of harmonics are
$\nu : \nu_1 : \nu_2 = \nu : 2\nu : 3\nu = 1 : 2 : 3$

*. Speed of wave in a stretched string → $v = \sqrt{\frac{T}{\mu}}$

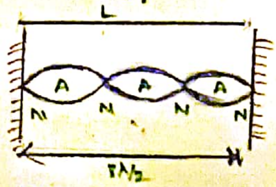
First mode $\lambda_1 = 2l$ frequency
$\nu_1 = \frac{v}{\lambda_1} = \frac{v}{2l} = \frac{1}{2l}\sqrt{\frac{T}{\mu}}$
∴ This frequency is called "first harmonic"



Second mode $\lambda_2 = L$ frequency
$\nu_2 = \frac{v}{\lambda_2} = \frac{v}{L} = 2\nu_1$
This frequency is called IInd harmonic or first overtone



Third mode $\lambda_3 = \frac{2L}{3}$ frequency
$\nu_3 = \frac{v}{\lambda_3} = \frac{3v}{2L} = 3\nu_1$ → 3rd harmonic & 2nd overtone.



n^{th} mode of frequency $\lambda_n = \frac{2L}{n}$, $f \rightarrow \nu_n = \frac{v}{\lambda_n} = \frac{nv}{2L} = n\nu_1 = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$
where $n = 1, 2, 3 \ldots$

DAMPED OSCILLATOR AND FORCED OSCILLATOR

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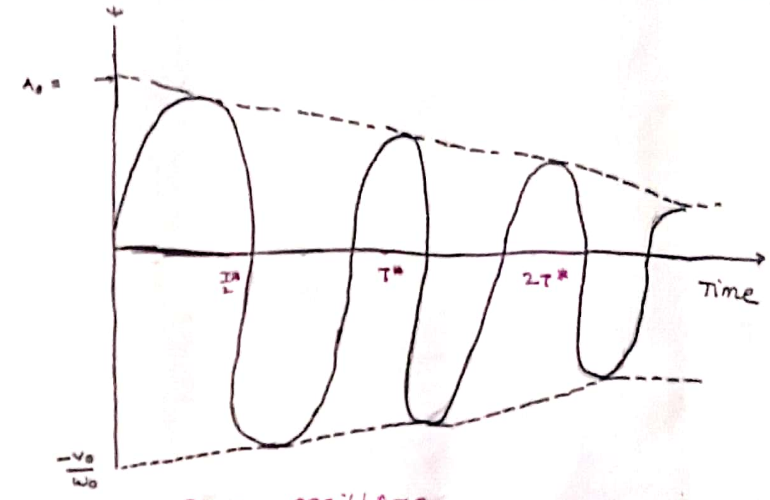
* DAMPED oscillation:

The damped is the resistance offered to the oscilations The oscillation that fades with time is called damped oscillation. Due to damping, the amplitude of oscilla-tion reduces with time. Reduction in amplitude of oscillation is the result of energy loss from the system is overcoming External force like friction or resistance and other resistive Force thus with the decrease the amplitude of the energy of the system Also keeps decreasing. They are two types

1. Natural damping 2. Artificial damping



DAMPED OSCILLATION

FORCED OSCILLATION :-

when a body oscillates by being influenced by an external periodic force is called Forced oscillation then the amplitude of the oscillation experience damping but remains constant due to the external energy. supplied to the system

Ex:- when you push someone on a swing you have a keep periodically pushing them so that the swing.

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ULTRASONICS DIFFERENT METHODS

Definition of Ultrasonics:

Ultrasonics is made up of two words "ULTRA" meaning BEYOND and "SONICS" meaning SOUND.

Sound waves in which the frequencies are above the limits of human audibility ie >20 KHz are called ULTRASONICS.

Production of Ultrasonics:

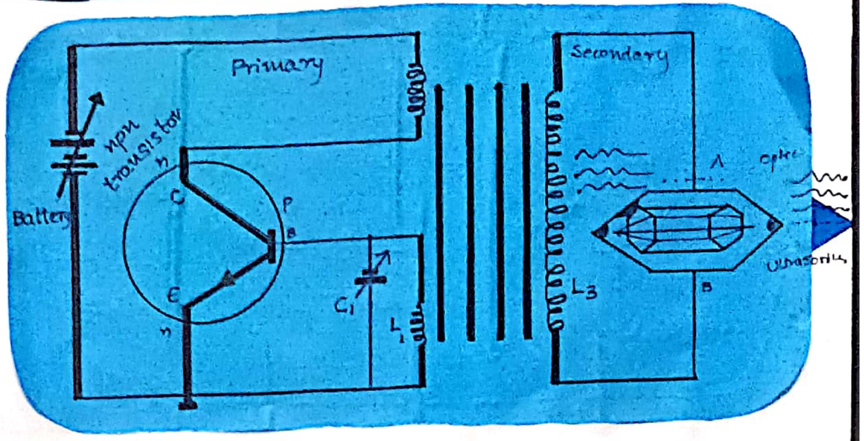
Ultrasonics can be produced by the following methods:

1] Piezo-electric Generator

2] Magneto-striction Generator

Piezo-electric Generator:

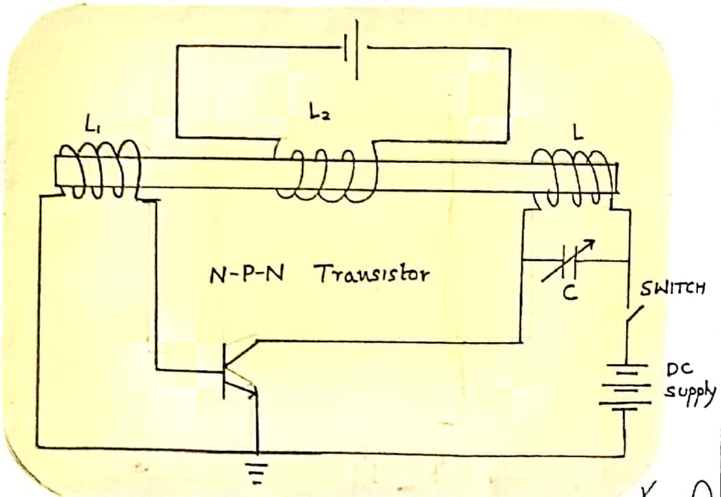
- If mechanical pressure is applied to the opposite faces of crystal, equal and opposite electrical charges appear across its other faces. This is called as Piezo-electric effect.



$$F = \frac{1}{2\pi\sqrt{L_1C_1}}$$

Magnetostriction Effect:

When a ferromagnetic rod like iron or a nickel is placed in a magnetic field parallel to its length, the rod experience a small changes in its length. This is called Magnetostriction effect.



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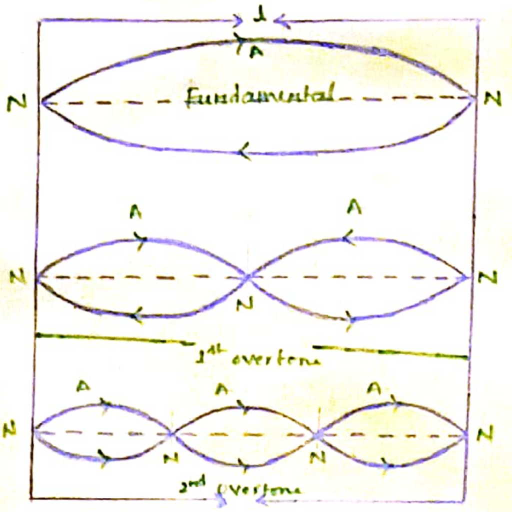
Modes of vibrations of stretched string



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In second mode of vibration, $P=2$, then
$\nu_1 = \frac{1}{2L}\sqrt{\frac{T}{\mu}} = 2\nu$ (2^{nd} harmonic or first over tone)

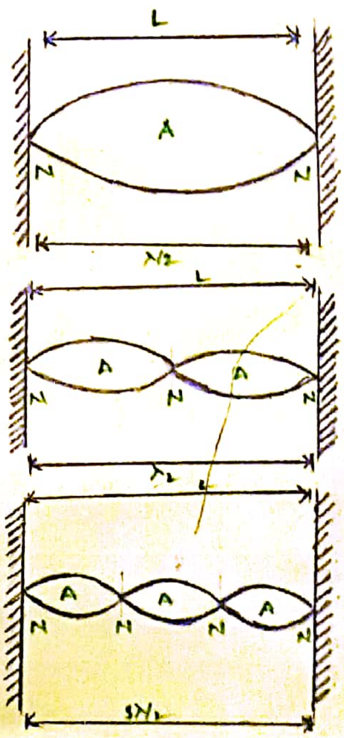
In third mode of vibration $P=3$ then
$\nu_2 = \frac{3}{2L}\sqrt{\frac{T}{\mu}} = 3\nu$ (3^{rd} harmonic or 2^{nd} over tone)

Ratio of frequency of harmonics are
$\nu : \nu_1 : \nu_2 = \nu : 2\nu : 3\nu = 1:2:3$

First mode $\lambda_1 = 2L$ frequency, $\nu_1 = \frac{\nu}{\lambda_1} = \frac{\nu}{2L} = \frac{1}{2L}\sqrt{\frac{T}{\mu}}$
This frequency is called 'first harmonic'.

Second mode $\lambda_2 = L$ frequency, $\nu_2 = \frac{\nu}{\lambda_2} = \frac{\nu}{L} = 2\nu_1$
This frequency is called '2^{nd} harmonic'.

Third mode $\lambda_3 = \frac{2L}{3}$ frequency, $\nu_3 = \frac{\nu}{\lambda_3} = \frac{3\nu}{2L} = 3\nu_1$
→ f is called '3^{rd} harmonic or 2^{nd} overtone'.



n^{th} mode of frequency $\lambda_n = \frac{2L}{n}$

$$f \rightarrow \nu_n = \frac{\nu}{\lambda_n} = \frac{n\nu}{2L} = n\nu_1 = \frac{n}{2L}\sqrt{\frac{T}{\mu}}$$

Where, $n = 1, 2, 3 \ldots\ldots$