lecture-8

chapter - 2

Simple harmonic motion:- when a force acting on a partical, if the ~~accelati~~ accelaration of the particle is proportional to the displacement from its equilibrium point but in opposite direction and the displacement remain the same either side of the equilibrium point, then the particle is called to execute simple harmonic motion.

"Differential equation of simple harmonic motion":-

Consider a ~~particlel~~ partical executing on a simple harmonic motion (shm) and F, force exerted (প্রয়োগ করা) on it. Then the displacement of the particle from the equilibrium position is y,

So, $F \propto -y$ | $K \rightarrow$ constant

or, $ma = -ky$

or, $m.\frac{d^2y}{dt^2}+ky=0$

or, $\frac{d^2y}{dt^2}+\frac{k}{m}y=0$

$w^2=\frac{k}{m}$

$w=\sqrt{\frac{k}{m}}$

$\therefore \boxed{\frac{d^2y}{dt^2}+w^2y=0}$ ---- ①

This is the required ~~equo~~ differential equation of simple harmonic motion.

Solution of simple harmonic Motion :- we have the, differential equation of simple harmonic motion,

$$\frac{d^2y}{dt^2}+w^2y=0 \text{ ---- } ①$$

marltipling the ~~or~~ equation by $2\frac{dy}{dt}$

or; $2\frac{dy}{dt}\cdot\frac{d^2y}{dt^2}+w^2y\cdot 2\frac{dy}{dt}=0$

or, $2\frac{dy}{dt}\cdot\frac{d^2y}{dt^2}=-w^2y\cdot 2\frac{dy}{dt}$ ---- ⑪

Integrating equation ② with respect to time,

$$\left(\frac{dy}{dt}\right)^2=-w^2y^2+c \text{ ---- } ③$$

where, c= intregral constant, when $\frac{dy}{dt}=0, y=a$

$$0 = -\omega^2 a^2 + c$$

$$\therefore c = \omega^2 a^2$$

$$\left(\frac{dy}{dt}\right)^2 = \omega^2 a^2 - \omega^2 y^2$$

or, $\dfrac{dy}{dt} = \sqrt{\omega^2 (a^2 - y^2)}$

or, $\dfrac{dy}{\sqrt{a^2 - y^2}} = \omega dt$ - - - ④

Intrating equation ④

$\sin^{-1}\left(\frac{y}{a}\right) = \omega t + \delta$, | δ = Intregration constant

or, $\dfrac{y}{a} = \sin(\omega t + \delta)$

$$\therefore y = a \sin(\omega t + \delta)$$

This is the required solution of the differential equation of Simple harmonic motion. where, phase $= (\omega t + \delta)$

Lecture-9

Lissajous Figure :- when a particle is influenced by two simple harmonic motions Simultaneously (একইসাথে) at right angle to each other, the resultant (ফলে) motion of particles traces a curve (বক্ররেখা). These curves are called lissajous figures. They are helpful in determining the ratio of the time periods of two vibration and to compare the frequencies of two turning forks

Lissajous Figerz.

Damped harmonic ~~os~~ ~~osc~~ oscillation /motion :- In actual practice a simple harmonic oscillator almost always vibrates in a resisting (প্রতিরোধ) medium Like air, oil etc. Consequently when the oscillator vibrates in Such a medium, energy is dissipated in each vibration in overcoming the ~~opposition~~ opposing frictional or viscous (সান্দ্রতা) forces. But in the presence of these forces the amplitude of vibration decreases continuously with time and finally the oscillations die out. Such vibrations are called free damped vibrations.

(পরবশ কম্পন)

Forced vibration :- when a body oscillation (দোলন) in a damped medium like air oil, it's amplitude falls exponentially with time to zero due to dissipation (অপচয়) of energy. of an external periodic force is constantly applied to the oscillator, a ~~so~~ short of tussle ensues between the damping force and the applied force. The damping force tends to retard (মন্থরিত করা) the motion of the body and the applied force tends to maintain it.

group
face > velocity
difference.

Initially ~~I~~ the amplitude of the oscillation
increases. Then decreases with time,
becomes minimum and again increases.
After some initial erratic (অনিশ্চিতভাবে) movements, the
body ultimately succumbs (বশিভূত হওয়া) to the applied
or driving force and settles down to
~~ore~~ oscillating with frequency of the
applied or driving force and a constant
amplitude and phase so long as the applied
force remain operative. Such vibrations of
the body are called forced vibration.

Group velocity (V_g):— waves can be in a group
and such groups are called wave packets,
So the valocity ~~are~~ with which a wave packet
travels is called group velocity.

$v_p = \frac{\omega}{k}$

$$v_g = \frac{d\omega}{dk}$$

where, ω = angular frequency (কৌণিক কম্পাঙ্ক)

k = weave number.

(পর্যায় গতি)

Phase valocity :- The valocity with which the phase of a wave travels is called phase velocity.

$$v_p = \frac{\omega}{K}$$

Group valocity	phase valocity
① The group valocity is defined only to the superimposed waves. (আরোপিত)	① phase valocity is defined for both the single waves and superimposed waves.
② The group velocity is the velocity ~~with~~ of the wave with lower frequency.	② The phase valocity is the valocity of the wave with higer frequency.

Resonance :– when a body is made to vibrate by the application of the external periodic (পর্যায়ক্রমিক) force and if the time period of the frequency of the applied force is different from the time periods of the body then the body will vibrate with very small amplitude (প্রশস্ততা) and the vibration does not last long. But if the time period of frequencies of both become equal the amplitude (প্রশস্ততা) of the vibration and its duration become large. ~~Vibration of the amplitude of vibration and its duration becomes~~ large. Vibration of this type is called resonance.

Lecture-10

The principle of superposition:- when two or more waves cross at a point, The displacement at that point is equal to the sum of the displacement of individual waves. The individual ~~di~~ wave displacement may be positive or negative. If the displacements are vactors, then the sum is calculated by vector addition.

super position is an importent idea that can explain the phenomena including interference (ব্যতিচার), differaction (বিবর্তন) (অপবর্তন) and standing (স্থির) waves. It works for any type of wave (sound wave, water surface wave, electromagnetic waves) but only works under certain conditions which we discribe bellow.

Condition of Superposition: ① The waves being superposed are of the same type ~~(electron~~ (all are electromagnetic waves).

② The medium at the waves are propagating (বিস্তার) through behaves linearly i.e. when part of the medium has twice the displacement then it has twice the restoring force. This is usually true when the amplitudes are very small.

For example, for waves on water, it is a good approximation [illegible] for small ripples [illegible] on a pond where amplitude is much smaller than their wavelength.

Interference (ব্যতিচার) of light :- In physics, * interference of light is a phenomenon in which two light waves supperpose to form a resultant wave of greater, lower or equal amplitude.

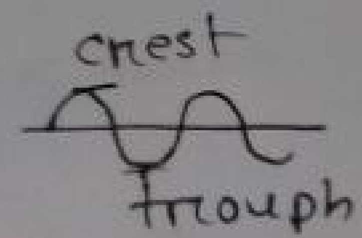
Interference usually refers to the interaction of waves that are correlated or coherent (সুসংহত) with each other, either because they come from the same source or because they have the same or nearly the same frequency.

without light waves, interference effects can be observed with all types of waves for example radio, Surface wather waves or matter waves.

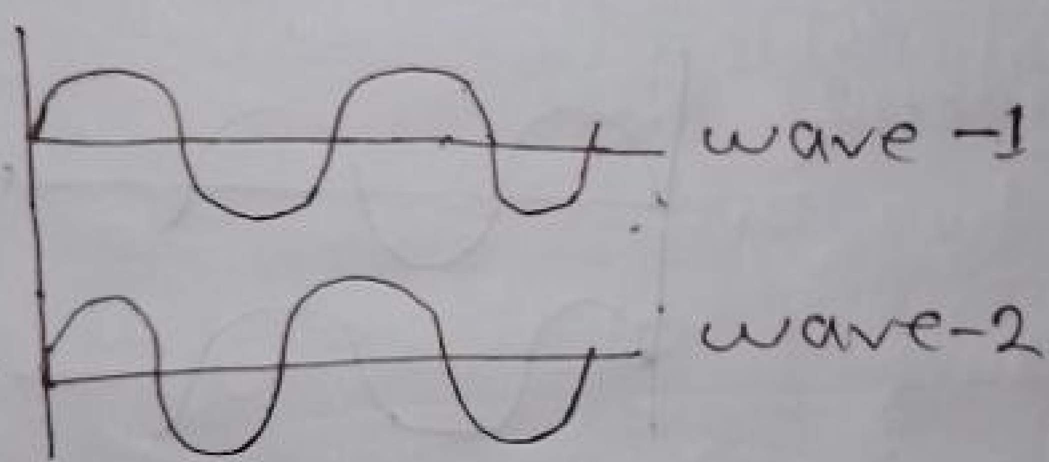
Types of Interference :-

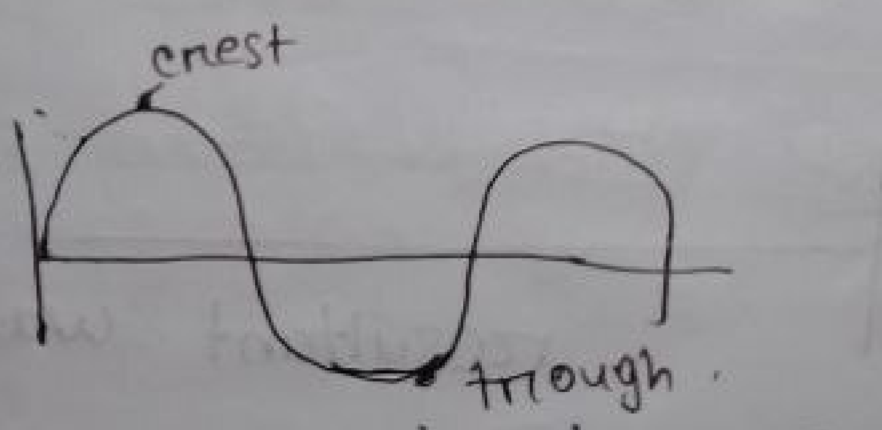
① Constructive interference.

② Destructive interference.



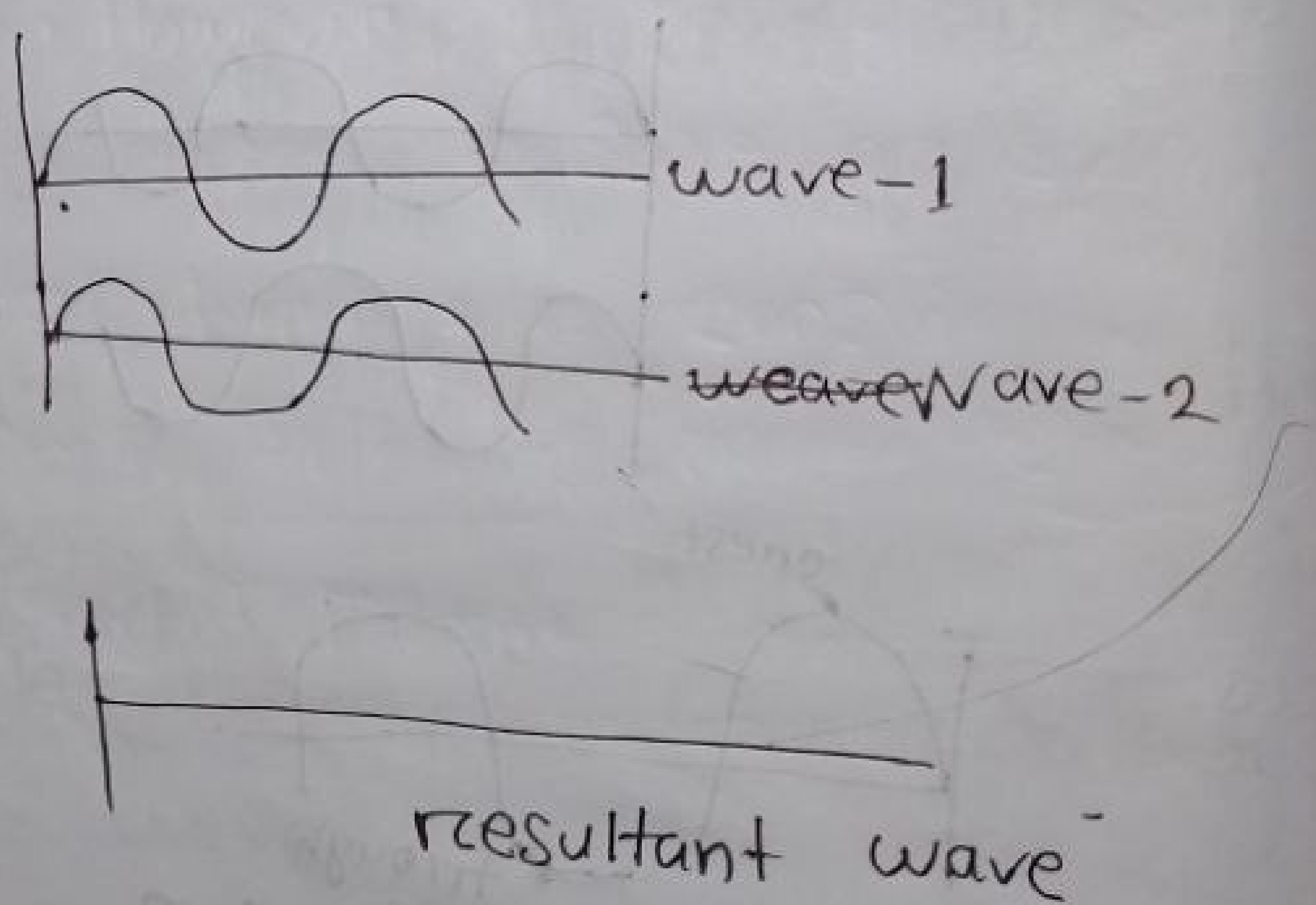
(গঠনমূলক ব্যতিচার)
Constructive interference:- When two light waves ~~supper~~ superpose with each other in such a way that the crest of one wave falls on the crest of the second wave and ~~through~~ the ~~of o~~ trough of one wave falls on the trough of second wave, then the resultant waves has larger amplitude and it is called constructive interference.





resultant wave.

(ধ্বংসাত্মক ব্যতিচার)
Destructive Interference:- when two light wa
Superpos with each other in such a way that the crest of one wave fall on the trough of the second wave and the trough of the one wave fall on the crest of the second wave. Then the resultant waves has zero amplitude and it is called destructive Interference.



5 tarikh

Lecture - 11

* Some important conditions for interference:-

① The two beams of light which interfere must be coherent i.e. must be originated from the same source of light.

② The two interfering waves must have the same amplitude otherwise the ~~interf~~ intensity will not zero at the regions of destructive interference.

③ The two beams of light should have zero phase difference.

④ The original source must be monochromatic

⑤ The two interfering waves must be propagated in almost the same diraction.
(প্রচার)

Diffraction:– (অপবর্তন) Diffraction is the slight bending of light as it passes around the edge (প্রান্ত) of an object. The amount of bending depends on the relative ~~[illegible]~~ size of the wave length of light to the size of the opening. If the opening is much larger then ~~the~~ light's wavelength (তরঙ্গদৈর্ঘ্য) the bending will be almost ~~unto~~ unnoticeable. However If the ~~opening is~~ the two are closer in size or equal, the amount of bending is considerable. and easily seem with the naked eye.

** Difference between ~~Fresnel's and Fraunhofer diffraction~~:*

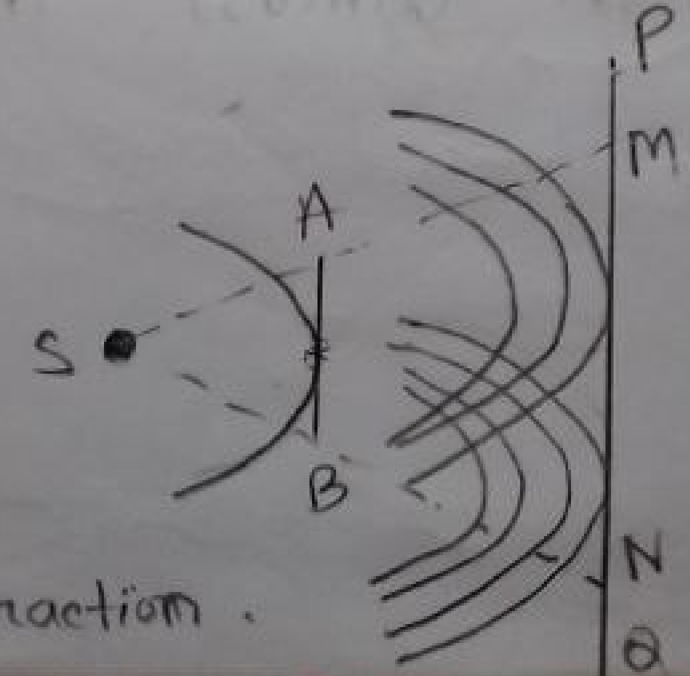


Fig:- Diffraction.

* Difference between Fresnel's and Fraunhofer Diffraction :-

Fraunhofer diffraction	Fresnel's diffraction.
① Source and the Screen are far away from each other.	① Source and Screen are not far away from each other.
② Incident wave fronts on the diffracting obstacle are plane.	② Incident wave fronts are spherical. (গোলাকার)
③ Diffracting ~~wave~~ obstacle give rise to wave fronts which are also plane.	~~③ No convex lens is needed to converge the sp.~~ ③ wave fronts leaving the obstacles are also spherical.
④ Plane diffracting wave fronts are converged by means of a convex (উত্তল) leans to produce diffracting pattern.	④ No convex leans is needed to converge the spherical wave fronts.

[Audible sound wave, Infrasonic sound wave,
20Hz – 20,000 Hz Below 20 Hz
Ultrasonic / Supersonic sound wave]
above 20,000 Hz

Audible sound wave:- ~~Ranging~~

Sound waves with frequency ranging from 20 Hz to 20 kHz is known as audible sound.

Infrasonic sound wave:- Sound wave with frequency ranging bellow 20 Hz is called as infrasonic ~~wa~~ sound wave.

Ultrasonic sound wave:- Sound waves with frequency ranging above 20,000 Hz is called ultrasonie sound wave.

Lecture — 12

Beats :- Beats are caused by the interference between two waves of the same amplitude, travelling with the same spead but having slightly different frequencies, f_1 and f_2. When two waves are added at a point in space, a pressure fluctuation is produced where frequency will be the average $(f_1+f_2)/2$, of the frequencies of the two original waves. However, as the two waves will Something raainforce each other and sometimes can-cel each other out, we will hear a variation in sound amplitude. The amplitude variation causes the perception of beats. The beat frequency will be $(f_1 - f_2)$ if f_1 is higher frequency.

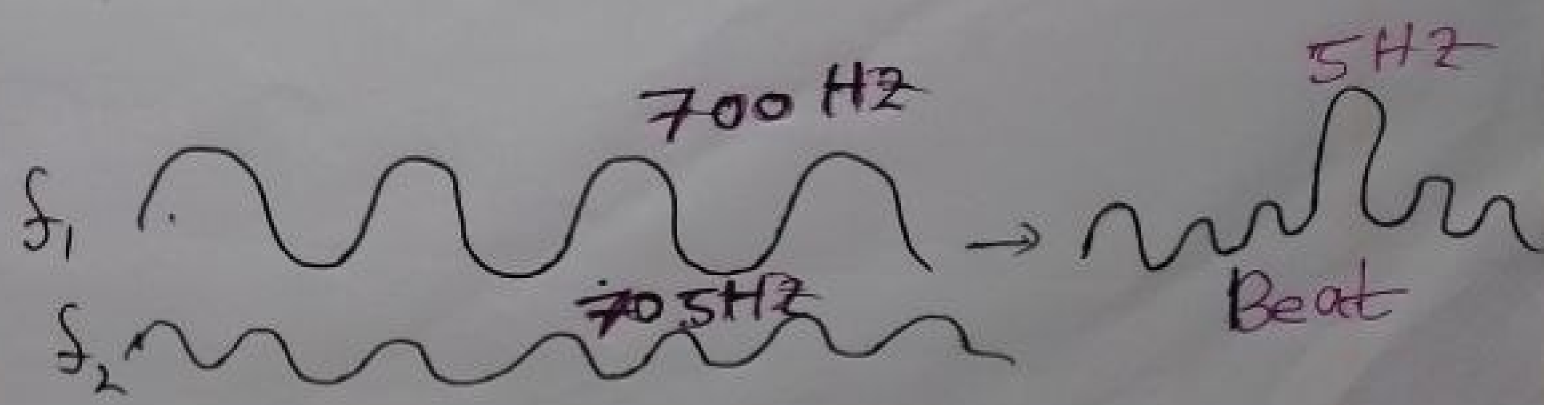


Figure.

Doppler effect :- Doppler effect is an increase or decrease in the frequency of sound, light or other waves an the source and observer move towards or away from each other. For example :- "while passing a siren of ambulance".

দূরে, কাছে যায়

কিরূপ: