Notes for — By, Dr. Bharat Singh (Page-1)
B.Sc. Part-I H.O.D Physics.
Paper-1st

Free, damped and forced oscillations.

Free oscillations :— When a body capable of oscillation is displaced from its equilibirium position and released, it begins to oscillate. The frequency of oscillations depends upon certain properties of the body. Such oscillations are called free oscillations. And their frequency is called the natural frequency of the body.

Usually the amplitudes of such oscillations gradually decreases to zero due to the presence of damping (friction, viscosity etc) forces. Hence, they are called the damped oscillations. Oscillations of simple pendulum is a simple example of such oscillations.

Damped oscillations :— When ever a system is set in to oscillations under no external influence, its amplitude decreases gradually to zero. This is because the oscillating system is always subject to friction or forces arising from air resistance or from within the system itself. The work done against these forces is dissipated out of the system as heat. Therefore, the mechanical energy of the system decreases with time and eventually the system comes to rest.

As an example, if we displace a pendulum from its equilibirium position it will oscillate with a decreasing amplitude and finally come to rest in the equilibirium position.

In most cases, the energy lost from the oscillating system in each cycle is similar to the →

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→ Previous cycle but of smaller amplitude. This happens when the frictional force is proportional to the velocity of the system.

Forced oscillations:→ When a body is set in oscillation under an external periodic force, then in the beginning the body tries to oscillate with its own natural frequency, but very soon these oscillations die out and the body oscillates with the frequency of the external applied force. Such oscillations are called forced oscillations. The amplitude of the forced oscillating depends upon the relation between the frequency of the applied force and the natural frequency of the body.

Example:— When a tuning fork is struck and its stem is placed on table, the table is set in oscillation with the frequency of the fork. Similarly when an alternating current is passed through a stretched string held between the poles of magnet, the string oscillates with the frequency of the current. These oscillations of the string are called the forced oscillations.

Resonance:— When a body is set in to oscillations by an external periodic force of the same frequency as the natural frequency of the body, the amplitude of oscillation is very much increased. This phenomenon is called "resonance".

Thus the resonance is a special case of forced oscillation.

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