

Constraints :-

The limitation or geometrical restrictions on the motion of a particle or system of particles generally known as constraints.

Example :-

(i) The motion of rigid body is always such that the distance between two particles remain unchanged.

(ii) A cylinder is restricted to move down an inclined plane.

(iii) The motion of gas molecules within a container is restricted by the wall of the container.

Classification of constraints :-

- (i) Holonomic
- (ii) Non-holonomic
- (iii) Scleronomous
- (iv) Rheonomic

(i) Holonomic constraints :- A constraint is said to be holonomic if the conditions of the constraint can be expressed in the form of an equation connecting the co-ordinates of the system and time.

Let  $r_1, r_2, \dots, r_n$  be the position co-ordinates of a system and  $t$  denotes the time; then expressed as equation having the form,

$$f(r_1, r_2, \dots, r_n, t) = 0$$

Example

(i) motion of a point mass in simple pendulum,  
 $(x-a)^2 = l^2$

(ii) A particle is restricted to move on the surface of a sphere.

(ii) Non-holonomic constraints

When  $f(r_1, r_2, \dots, r_n, t) \neq 0$ .

then the constraints are called non-holonomic.

Example

- (a) motion of the particles placed on the surface of the solid sphere.
- (b) motion of the molecules in a gas container.
- (c) An object rolling on a rough surface without slipping.

(iii) Scleronomic constraint

A constraint which is independent of time is known as Scleronomic constraint.

Example :- A rigid body is a system of particles in which the distance between any pair of particles remains constant with time.

(iv) Rheonomic constraints

A constraint which is dependent on time explicitly is known as rheonomic constraints.

Example :- A simple pendulum suspended from a moving support so that the length of the pendulum change with time.