MODULE V
KINEMATICS

1. **What is centrifugal force? What is super elevation? (Dec2014 /Jan 2015)**
   Solution.

   When a body moves in a circular path on a radius R, its magnitude of speed is constant but the direction of velocity is continuously changing. Thus the particle experiences acceleration towards the centre of the circle of magnitude V2/R, hence the inertia force acts in radially outwards direction. This force is known as **centrifugal force**. To avoid undesirable conditions, such as skidding and overturning the outer edge of the pavement on highway curves and outer rail on railway curves are elevated above the inner edge or the inner rail. This raising of outer edge or outer rail above the inner edge or inner rail by certain amount is called **super elevation**.

2. **Determine the position at which the ball is thrown up the plane will strike the inclined plane as shown in fig. the initial velocity 30m/s and angle of projection is $Tan{-1}(4/3)$ with horizontal.**   **(Dec2014 /Jan 2015)**

   Solution.

   $X = 2y$

   Horizontal component μ_x
   $= u\cos\theta = 18m/s$

   vertical component $\mu_y =$
   $u\sin\theta = 24m/s$

   $y = u\sin\theta \times t - 9t^2$ $y =$
   $24t - 4.905t^2$ $x = 2y =$
   $u\cos\theta \times t = 18t$

   $y = 9t$, t=3.058sec, X = 55.046s, Y = 27.523s

3. **A stone is dropped from the top of the tower 50m high. At the same time another stone is thrown up from the tower with a velocity of 25m/sec . At what distance from the top and after how much time the two stones cross each other? (Dec2014 /Jan 2015)**

   $h_1+h_2 = 50$

   Stone (1)

   $U= 0$ $h = b_1$

   $G = 9.81 \text{ m/ sec}^2$ h
   $= ut + 0.5gt^2$

Stone (2)

U= 25 m/sec, h=h^2, g= -9.81 m/sec^2

$h_2 = 25t – 0.5 *9.81 t_2$ $h_2 = 25t –$

$4.905 t_2$

Substituting t=25 , h_1 =19.6 m

4. **What is projectile? Define the following terms briefly)Angle of projection   ii) Horizontal range iii) Vertical height iv) Time of fight**   **(Dec2014 /Jan 2015)**
   Solution.

   Angle of projection (α): It is the angle with which the projectile is projected with respect to horizontal.

   Time of flight (T): It is the total time required for the projectile to travel from the point of projection to the point of target.

   Horizontal range (R): It is the horizontal distance between the point of projection and target point.

   Vertical height (h): It is the vertical distance/height reached by the projectile from the point of projection.

5. **A burglar's car starts at an acceleration of 2m/s2. A police vigilant party came after 5s and continued to chase the burgler's car with a uniform velocity of 20m/s. find the time taken in which the police van will overtake the car. (Dec2014 /Jan 2015)**

   Solution.
   For burglar's car   u=o , a=2m/sec^2

   Let t= time taken by police van and overtaking burglar's car

   As the police van came after 5sec , hence burglar's car will be in motion for (t+5)sec uniform velocity of police van = 20 m/sec.

   When police van will overtake burglar's car , then distance travelled by both vans will be   same.

   Therefore distance travelled by police van = uniform velocity *t

   S=20t

The distance travelled by burglar''s car in (t+5)sec is

$$S = ut + 0.5\ at^2$$
$$S = 0 + (t+5)^2$$

Then equating both distance i.e

$$20t = (t+5)^2$$
$$20t = t2 + 25t + 10t$$

$$(t-5)^2 = 0$$

t=5sec