

Section – A

1. a) Find the tangent and normal components of velocity and acceleration. 5
 b) Find the radial and transverse components of acceleration of a particle moving along the circle $x^2 + y^2 = a^2$ with constant angular velocity c . 5

2. a) A particle moves in a straight line with an acceleration KV^3 if its initial velocity is u , find the velocity and the time spent when the particle has travelled a distance x . 5
 b) A particle describes S.H.M in such a way that its velocity and acceleration at point 'p' are 'u' and 'f', respectively and the corresponding quantities at another point Q are 'v' and 'g' Find the distance PQ. 5

3. a) A shell bursts on contact with the ground and pieces from it fly in all directions with all speed up to 80 feet per second. Prove that a man 100 feet away is in danger for $\frac{5}{\sqrt{2}}$ seconds. 5
 b) The range of a rifle bullet is 1200 yards when α is the elevation of projection, show that if the rifle is fired with the same elevation from a car travelling at 10 miles per hour toward the target, the range will be increased by $220 \sqrt{\tan \alpha}$ feet. 5

4. a) Show that the law of force towards the pole of a particle describing the curve $r^n = a^n \cos n \theta$ is given by $f = \frac{(n+1)h^2 a^{2n}}{r^{2n+3}}$ 5
 b) A particle describes the curve $r^n \cos n \theta = a^n$ under force F to the pole, show that the force is as stated $F \propto r^{2n-3}$. 5

5. a) Show that $\vec{F} = -kr^3 \vec{r}$ is conservative. Find the Potential Energy of a particle in the field of this force. 5
 b) Show that when a particle moves under a central force the areal velocity is constant. 5

Section – B

6. a) Determine the positive real root of $4\sin x = e^x$ upto four decimal places by using Newton Raphson Method in the interval (0, 0.5). 5
 b) Solve the equation $f(x) = 2e^{-x} - \sin x$ Using Bisection Method. 5

7. a) Solve by Gauss-Seidal Iteration: 5

$$2x_1 + 20x_2 - 2x_3 = -44$$

$$10x_1 + 2x_2 + x_3 = 9$$

$$-2x_1 + 3x_2 + 10x_3 = 22$$
 b) Find by simple iteration to five decimal places the root near 0.5 of the equation $\sin x = 5x - 2$. 5

8. a) Evaluate $\int_0^1 \frac{dx}{2+x^2}$ by Simpson's Rule with seven points and compare your result with exact value. 5
 b) Evaluate the integral $\int_1^2 \frac{dx}{1+x^4}$ using Trapezoidal Rule for $n = 6$. 5