

Indian Institute of Science Education and Research Kolkata
Department of Physical Sciences

PH1101 :: Physics I
End-semester Examination (Autumn 2018)
Marks: 50, Duration: 3 hours

1. Using definition show that $\frac{dx^n}{dx} = n x^{n-1}$ where n is a positive definite integer. [3]
2. Find the locations and the corresponding values of the finite maxima and minima of the potential function $U(x) = x^4 - x^2$. [5]
3. Show that the vectors $\vec{A} = 2\hat{i} + 3\hat{j}$, $\vec{V} = 7\hat{j}$ and $\vec{C} = \hat{i} - 9\hat{j}$ are co-planar. [4]
4. Prove that the total linear momentum of an isolated system of N interacting particles is a conserved quantity. [5]
5. Find the position of the center of mass of a thin rod of length l whose density varies from a given end as $\rho = \rho_0 l^{-4} x^4$. [4]
6. Compute the angular momentum of a particle of mass m which is moving along a straight line with the trajectory $\vec{r} = 7x(t)\hat{i} + 3\hat{j}$. [4]
7. Find the Fourier series expansion of the function $g(t) = |t|$ in the domain $-\pi < t < \pi$. [5]
8. Find the Taylor series of the function $f(x) = \frac{1}{x-1}$ around $x = 0$. What should be the domain of convergence of this series and why? [5]
9. Solve the differential equation along with the initial conditions $y(0) = 1$ and $y'(0) = -1$ [7]

$$\frac{d^2y(x)}{dx^2} + 2\frac{dy(x)}{dx} + 26y(x) = 0.$$

10. A particle of mass m is allowed to move only along z-axis and it is being acted upon by a force $F = -m\omega^2 z(t) + ma_0 \cos(\Omega t)$. Find the general solution for the position of the particle. [8]