

PH121: Physics - II

Marks : 30

Quiz-1

Date : 02/05/2022

(Answer any three questions. All questions carry equal marks)

- 1) a. Find a unit vector normal to the surface $x^2y + xz = 3$ at the point $(1, -1, 1)$. (2 marks)
b. Show that $\vec{F} = (2xy + z^2)\hat{i} + x^2\hat{j} + xyz\hat{k}$ is a conservative force field. Find the corresponding scalar potential. Find the work done in moving a unit mass in this field from the point $(1, 0, 1)$ to $(2, 1, -1)$. (3+2.5+2.5 marks)

- 2) (a) If the electric field is $\vec{E} = 30e^{-r}\hat{r} - 2z\hat{k}$ in cylindrical coordinates, then prove divergence Gauss theorem for a volume (cylinder) enclosed by $r=2$, $z=0$ and $z=5$. (Marks 5)

- (b) Find which one of the following two is incorrect electric field and why. (Mark 5)

- i) $xy\hat{i} + 2yz\hat{j} + 3xy\hat{k}$
ii) $y^2\hat{i} + (2xy + z^2)\hat{j} + 2yz\hat{k}$

- 3) Consider a sphere of radius "a" with charge density function as $\rho(r) = k/r^2$. A concentric spherical shells of uniform surface charge distribution and radius b surrounds the sphere ($b > a$). The charge densities are such that the total charge with the inner sphere is equal an opposite that of total charge on the outer sphere. Derive the electric field and potential at three places. Namely, inside the inner sphere, between the sphere and shell and outside the outer sphere. Draw the magnitude of electric field and potential as a function of distance from the centre of the shells.

- 4) A sphere of radius R carries a charge density of $\rho(r) = cr^2$ (where c is constant). Find the energy of the configuration by two methods. First by using the electric field alone and second by using the resulting potential.

- 5) a. Find whether $\vec{E} = r^2\sin\theta\hat{r} + 4r^2\cos\theta\hat{\theta} + r^2\tan\theta\hat{\phi}$ obeys Gauss divergence theorem or not. (Marks 4)

- b. Show that (Mark 3)

$$x \frac{d}{dx}(\delta(x)) = -\delta(x)$$

- c. Evaluate (Mark 3)

$$\int_0^3 x^3 \delta(x+1) dx.$$