

Q.1 it is given that

$$\mathbf{F} = (3x^2 - 6yz)\mathbf{i} + (2y + 3xz)\mathbf{j} + (1 - xyz^2)\mathbf{k}.$$

Evaluate the line integral $\int_C \mathbf{F} \cdot d\mathbf{l}$ from the point $(0,0,0)$ to the point $(1,1,1)$ along the curve C parametrized as $x(t) = t, y(t) = t^2, z(t) = t^3$.

Q.2 Given the two force fields

$$\mathbf{F}_1 = -2y\mathbf{i} + (z - 2x)\mathbf{j} + (y + z)\mathbf{k}, \quad \mathbf{F}_2 = y\mathbf{i} + 2x\mathbf{j},$$

- Determine whether \mathbf{F}_1 and \mathbf{F}_2 are conservative or not.
- Find the work done by \mathbf{F}_1 and \mathbf{F}_2 in moving a particle around the ellipse $x^2 + \frac{y^2}{4} = 1$.
- Find potential(s) associated to conservative force(s) in this problem.

Q.3 Evaluate the line integral $\int_C \vec{\mathbf{V}} \cdot d\vec{\mathbf{r}}$ where C is the helix

$$x(t) = \cos t, \quad y(t) = \sin t, \quad z = t,$$

between the points $(1, 0, 0)$ and $(1, 0, 2\pi)$ where $\vec{\mathbf{V}}$ is the vector field

$$\vec{\mathbf{V}} = \sin(yz)\mathbf{i} + xz \cos(yz)\mathbf{j} + xy \cos(yz)\mathbf{k}.$$

Q.4 Check if the following vector fields are conservative and find a potential function if so.

- $\mathbf{F} = y \sin 2x\mathbf{i} + \sin^2 x\mathbf{j}$.
- $\mathbf{F} = z^2 \sinh y\mathbf{j} + 2z \cosh^2 y\mathbf{k}$
- $\mathbf{F} = y\mathbf{i} + x\mathbf{j} + \mathbf{k}$

Q.5 Compute the line integral of

$$\mathbf{F} = x^2\mathbf{i} + 5x\mathbf{j},$$

around a square with vertices at $(1, 0), (0, 1), (-1, 0), (0, -1)$.