Q.1 It is given that $\boldsymbol{F} = (3x - yz)\boldsymbol{i} + (z^2 - y^2)\boldsymbol{j} + (2yz + x^2)\boldsymbol{k}$,

a. Evaluate the surface integral $\oiint_S \boldsymbol{F} \cdot d\boldsymbol{\sigma}$ over the surface of the sphere $(x-2)^2 + (y+3)^2 + z^2 = 9$.

b. Verify divergence theorem.

Q.2 Consider the vector field given as $\vec{\boldsymbol{V}} = (x^2 + 3x)\boldsymbol{i} + (3y^2 + 3y)\boldsymbol{j} - 2z(x_3 y - 2)\boldsymbol{k}$.

a. Evaluate the surface integral $\oiint_S \boldsymbol{V} \cdot d\boldsymbol{\sigma}$ over the surface of the unit cube $0 \leq x \leq 1$, $0 \leq y \leq 1$,$0 \leq z \leq 1$.

b. Verify the divergence theorem.

Q.3 Given that $\boldsymbol{V} = (1+y)z\boldsymbol{i} + (1+z)x\boldsymbol{j} + (1+x)y\boldsymbol{k}$, use Stokes' theorem to evaluate $\oint_C \boldsymbol{V} \cdot d\boldsymbol{r}$, where C is a closed curve in the plane $x - 2y + z = 1$. Ans: 0.

Q.4 Consider the vector field $\vec{\boldsymbol{V}} = (x^2 + z)\boldsymbol{i} + (y^2 + x)\boldsymbol{j} + (z^2 + y)\boldsymbol{k}$ and let C be the curve of intersection of the sphere $x^2 + y^2 + z^2 = 1$ and the cone $z = \sqrt{x^2 + y^2}$.

a. Compute $\oint_C \vec{\boldsymbol{V}} \cdot d\vec{\boldsymbol{r}}$ along the curve C directly.

b. Compute $\oint_C \vec{\boldsymbol{V}} \cdot d\vec{\boldsymbol{r}}$ using Stokes' theorem.