Malaviya National Institute of Technology Jaipur

Department of Physics, Tutorial-1

Class: B.Tech (Physics) Course Code: Physics (PHT-101)

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1. Using Gauss-divergence theorem, evaluate $\oiint_S \vec{F}.\vec{ds}$, where, $\vec{F} = 4xz\hat{\imath} - y^2\hat{\jmath} + yz\hat{k}$ and S is the surface of a cube bounded by $x = 0, x = 1, y = 0, y = 1, z = 0, z = 1$.

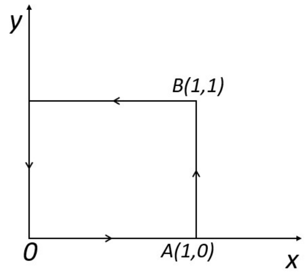
2. Apply the Divergence theorem to compute $\oiint_S \vec{u}.\vec{ds}$, where S is the surface of the cylinder $x^2 + y^2 = a^2$ bounded by the planes $z = 0, z = b$. $\vec{u} = x\hat{\imath} - y\hat{\jmath} + z\hat{k}$.

3. Evaluate $\oiint_S (3x\hat{\imath} + 2y\hat{\jmath}).\vec{ds}$, where S is the sphere $x^2 + y^2 + z^2 = 9$.

4. Evaluate $\oiint_S (y^2z\hat{\imath} + y^3\hat{\jmath} + xz\hat{k}).\vec{ds}$, where S is the boundary of the cube defined by $-1 \leq x \leq 1$, $-1 \leq y \leq 1$ and $0 \leq z \leq 2$.

5. Verify the Divergence theorem where, $\vec{F} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ and S is the surface composed of the upper half of the sphere of radius a and center at the origin, together with the circular disc in the xy-plane centered at the origin and of radius a.

6. Verify Stoke's theorem for $\vec{F} = x^2\hat{\imath} + 2x\hat{\jmath} + z^2\hat{k}$ for the square shown below, defined by the side $y = 0$, $x = 1$, $y = 1$ and $x = 0$.



7. Using Stoke's theorem evaluate $\oint_C [(2x-y)dx - yz^2dy - y^2zdz]$ where C is the circle $x^2+y^2 = 1$, corresponding to the surface of sphere of unit radius.

8. Using Stoke's theorem evaluate $\oint_C [(x+2y)dx + (x-z)dy + (y-z)dz]$ where C is the boundary of the triangle with vertices (2,0,0), (0,3,0) and (0,0,6) oriented in the anticlockwise direction.

9. Prove that $curl(grad\Phi) = 0$ using Stoke's theorem.

10. Suppose S_1 and S_2 are two oriented surfaces that share C as boundary. What can you say about

$$\oiint_{S_1} curl\vec{F}.\vec{ds}$$

and

$$\oiint_{S_2} curl\vec{F}.\vec{ds}$$