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S.Y.B.Sc. (Sem. III) (CBCS)
MATHEMATICS
PAPER-301
UNIT-3
Vector Differentiation

Question Bank

☑**Answer the following:** **[1 mark Questions]**

1) Find gradient of the surface $x^2+y^2-z=4$ at point (2, 0, 0).
2) If $\bar{a} = 2\hat{i} - \hat{j} - 2\hat{k}$ then find unit vector of $\bar{a}$.
3) In usual notation $div\bar{r} =$ ________.
4) If $\bar{f} = x^2y\hat{i} - 2xz\hat{j} + 2yz\hat{k}$ then find $\nabla \times \bar{f}$.
5) If $\bar{f} = (x^3, y^3, z^3)$ then find $div\bar{f}$.
6) If $\bar{f} = (x, y, z)$ then find $curl\bar{f}$.
7) Define: Scalar point function
8) Define: Vector point function
9) Define: Gradient
10) Define: Divergence
11) Define: Curl
12) If $\emptyset = x^3 + y^3 + z^3$ then find $grad\emptyset$.
13) If $\emptyset = x^2 + y^2 + z^2$ then find $\nabla\emptyset$.
14) If $f = 2x^2y + 3y^3 + 3z^2$ then find $\nabla^2 f$.
15) If $f = x^2yz$ then find $\nabla^2 f$.
16) If $f = xy + yz + zx$ then find $\nabla^2 f$.
17) If $f = x^2y + y^2z + z^2x$ then find ∇f.
18) Define: Solenoidal vector
19) Define: Irrotational vector
20) Define: Laplace equation

☑Answer the following: [2 mark Questions]

1) In usual notation prove that $div(\emptyset\bar{f}) = \emptyset div\bar{f} + \bar{f} \cdot grad\emptyset$, where $\bar{f}$ is vector function and Ø is scalar function.
2) For a scalar function Ø on D, prove that $curl(grad\emptyset) = \bar{0}$.
3) If $\bar{f} = x^2y\hat{\imath} - 2xz\hat{\jmath} + 2yz\hat{k}$ then find $curl\bar{f}$.
4) Prove that $div(\bar{r} \times \bar{a}) = 0$, where $\bar{a}$ is a constant vector.
5) $\emptyset(x, y, z) = x^2y + y^2z + z^2$ then find unit normal at (1, 1, 1).
6) If $\bar{u} = \log(x^2 + y^2 + z^2)$ then find (i) $grad\bar{u}$ and (ii) $div(grad\bar{u})$ at the point (1, 2, 3).
7) If $\emptyset(x, y, z) = x^3y + xy^3 + zxy$ then find ∇Ø.

☑Answer the following: [3 mark Questions]

1) If $\bar{f} = x^2y\hat{\imath} - 2xz\hat{\jmath} + 2yz\hat{k}$ then find $curl\bar{f}$ and $div\bar{f}$.
2) If $\bar{f}$ is Solenoidal function then find a, where $\bar{f} = (ax + 3y + 4z)\hat{\imath} + (x - 2y + 3z)\hat{\jmath} + (3x + 2y - z)\hat{k}$.
3) If $\bar{f}$ is Irrotational then find a, b, c
   Where, $\bar{f} = (2x + 3y + az)\hat{\imath} + (bx + 2y + 3z)\hat{\jmath} + (2x + cy + 3z)\hat{k}$.
4) If $r = \bar{r}$, where $\bar{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ then prove that $\nabla f(r) = f^{'}(r)\frac{\bar{r}}{r}$.
5) In usual notation prove that $div(curl\bar{f}) = 0$.
6) Prove in usual notation $div(r^n\bar{r}) = (n + 3)r^n$.
7) $\bar{f} = x^2yz\hat{\imath} + xy^2z\hat{\jmath} + xyz^2\hat{k}$ then find $(\nabla \times \bar{f})$ at (1, 2, 3).
8) In usual notation prove that $curl(\emptyset\bar{f}) = \emptyset curl\bar{f} + (grad\emptyset) \times \bar{f}$
9) If $\bar{f} = (x^3, y^3, z^3)$ then prove $curl\bar{f} = 0$ & $grad(div\bar{f}) = 6\bar{r}$.

☑Answer the following: [5 mark Questions]

1) Prove that $\nabla^2(\emptyset\psi) = \emptyset\nabla^2\psi + 2\nabla\emptyset\psi + \psi\nabla^2\emptyset$.
2) Prove that $\frac{1}{r}$ satisfies the Laplace equation.
3) In usual notation prove that $div(\bar{f} \times \bar{g}) = \bar{g} \cdot curl\bar{f} - \bar{f} \cdot curl\bar{g}$.
4) In usual notation prove that $\nabla^2 f(\bar{r}) = f^{n}(r) + \frac{2}{r}f^{'}(r)$.

5) Prove that $\frac{1}{r}$ satisfies the Laplace equation, also prove if $r = |\bar{r}|$ then $curl(grad r^n) = \bar{0}$, where $\bar{r} = (x, y, z)$.
6) Prove that the function $H = e^{-\lambda x}(C_1 sin\lambda y + C_2 cos\lambda y)$ satisfies the Laplace equation, where λ, C_1, C_2 are constants.
7) If $\bar{F} = grad(x^3 + y^3 + z^3 - xyz)$ then prove $grad(div\bar{F}) = 6(\hat{i} + \hat{j} + \hat{k})$.

******* BEST OF LUCK*******