8. a) If $\vec{F} = (x + y + az)\hat{i} + (bx + 2y - z)\hat{j} + (x + cy + 2z)\hat{k}$. Find a, b, c such that $\vec{F}$ is irrotational then find ϕ such that $\vec{F} = \nabla\phi$.

b) If ϕ is a scalar point function and $\vec{F}$ is a vector point function then prove that $\text{div}\left(\phi\vec{F}\right) = \phi\left(\text{div}\vec{F}\right) + (\text{grad}\phi).\vec{F}$.

OR

9. a) If $\vec{F} = x^2yz\,\hat{i} + xy^2z\,\hat{j} + xyz^2\hat{k}$ and $\phi = xyz$ find $\text{div}\left(\phi\vec{F}\right)$.

b) If $\vec{F} = x^2y\,\hat{i} - 2xz\,\hat{j} + 2yz\hat{k}$ find $\text{curl}\left(\text{curl}\vec{F}\right)$.

PART – D

Answer **two full** questions : **(2×10=20)**

10. a) Use the method of separation of symbols. Prove that

$$u_0 + u_1x + u_2x^2 + \ldots \text{ to } \infty = \frac{u_0}{(1-x)} + \frac{x\,\Delta u_0}{(1-x)^2} + \frac{x^2\Delta^2 u_0}{(1-x)^3} + \ldots \text{ to } \infty.$$

b) Find f(2.5) from the following data :

x	1	2	3	4	5	6
f(x)	1	8	27	64	125	216

OR

11. a) Find the cubic polynomial which takes the following values :

x	0	1	2	3
f(x)	1	2	1	10

b) Using Simpson's $\frac{1}{3}^{rd}$ rule evaluate $\int_0^{0.6} e^{-x^2}\,dx$.

12. a) Evaluate :

i) $\Delta(e^{2x}\log 3x)$ (take h = 1)

ii) $\Delta(\tan^{-1}x)$ (take h = 1).