UNIT – II: VECTOR CALCULUS

1. The directional derivative of $\phi = xy + yz + zx$ at the point (1,2,3) along x - axis is
   (a) 4 (b) 5 (c) 6 (d) 0

2. In what direction from (3, 1, -2) is the directional derivative of $\phi = x^2 y^2 z^4$ maximum?
   a) $\frac{1}{\sqrt{19}}(\vec{i} + 3\vec{j} - \vec{k})$ (b) $19(\vec{i} + 3\vec{j} - 3\vec{k})$
   (c) $96(\vec{i} + 3\vec{j} - 3\vec{k})$ d) $\frac{1}{\sqrt{19}}(3\vec{i} + 3\vec{j} - \vec{k})$

3. If $\vec{r}$ is the position vector of the point (x, y, z) w. r. to the origin, then $\nabla \cdot \vec{r}$ is
   (a) 2 (b) 3 (c) 0 (d) 1

4. If $\vec{r}$ is the position vector of the point (x, y, z) w. r. to the origin, then $\nabla \times \vec{r}$ is
   a) $\nabla \times \vec{r} = 0$ b) $x\vec{i} + y\vec{j} + z\vec{k} = 0$ c) $\nabla \times \vec{r} \neq 0$ d) $\vec{i} + \vec{j} + \vec{k} = 0$

5. The unit vector normal to the surface $x^2 + y^2 - z^2 = 1$ at (1, 1, 1) is
   a) $\frac{\vec{i} + \vec{j} - \vec{k}}{\sqrt{3}}$ b) $\frac{2\vec{i} + 2\vec{j} - 2\vec{k}}{\sqrt{2}}$ c) $\frac{3\vec{i} + 3\vec{j} - 3\vec{k}}{2\sqrt{3}}$ d) $\frac{\vec{i} + \vec{j} - \vec{k}}{3\sqrt{2}}$

6. If $\phi = xyz,$ then $\nabla\phi$ is
   a) $yz\vec{i} + zx\vec{j} + xy\vec{k}$ b) $xy\vec{i} + yz\vec{j} + zx\vec{k}$ c) $zx\vec{i} + xy\vec{j} + yz\vec{k}$ d) 0

7. If $\vec{F} = (x + 3y)\vec{i} + (y - 3z)\vec{j} + (x - 2z)\vec{k}$ then $\vec{F}$ is
   a) solenoidal b) irrotational c) constant vector
   d) both solenoidal and irrotational

8. If $\vec{F} = (axy - z^3)\vec{i} + (a - 2)x^2\vec{j} + (1 - a)xz^2\vec{k}$ is irrotational then the value of a is
   a) 0 b) 4 c) -1 d) 2

9. If $\vec{u}$ and $\vec{v}$ are irrotational then $\vec{u} \times \vec{v}$ is
   a) solenoidal b) irrotational c) constant vector d) zero vector

10. If ϕ and ψ are scalar functions then $\nabla\phi\times\nabla\psi$ is

a) solenoidal b) irrotational c) constant vector

d) both solenoidal and irrotational

11. If $\vec{F} = \left(y^2 - z^2 + 3yz - 2x\right)\vec{i} + \left(3xz + 2xy\right)\vec{j} + \left(3xy - 2xz + 2z\right)\vec{k}$ then $\vec{F}$ is

a) solenoidal b) irrotational c) both solenoidal and irrotational

d) neither solenoidal nor irrotational

12. If $\vec{a}$ is a constant vector and $\vec{r}$ is the position vector of the point (x, y, z) w. r. to the origin then $grad(\vec{a}\cdot\vec{r})$ is

a) 0 b) 1 c) $\vec{a}$ d) $\vec{r}$

13. If $\vec{a}$ is a constant vector and $\vec{r}$ is the position vector of the point (x, y, z) w. r. to the origin then $div(\vec{a}\times\vec{r})$ is

a) 0 b) 1 c) $\vec{a}$ d) $\vec{r}$

14. If $\vec{a}$ is a constant vector and $\vec{r}$ is the position vector of the point (x, y, z) w. r. to the origin then $curl(\vec{a}\times\vec{r})$ is

a) 0 b) 1 c) $2\vec{a}$ d) $2\vec{r}$

15. If ϕ scalar functions then $curl(grad\phi)$ is

a) solenoidal b) irrotational c) constant vector d) 0

16. If the value of $\int_A^B \vec{F}\cdot d\vec{r}$ does not depend on the curve C, but only on the terminal points A and B then $\vec{F}$ is called

a) solenoidal vector b) irrotational vector c) conservative vector

d) neither conservative nor irrotational

17. The condition for $\vec{F}$ to be Conservative is, $\vec{F}$ should be

a) solenoidal vector b) irrotational vector c) rotational

d) neither solenoidal nor irrotational

18. The value of $\int_C \vec{r} \cdot d\vec{r}$ where C is the line $y = x$ in the xy-plane from (1,1) to (2,2) is

a) 0 b) 1 c) 2 d) 3

19. The work done by the conservative force when it moves a particle around a closed curve is

a) $\nabla \cdot \vec{F} = 0$ b) $\nabla \times \vec{F} = 0$ c) 0 d) $\nabla \cdot (\nabla \times \vec{F}) = 0$

20. The connection between a line integral and a double integral is known as
a) Green's theorem b) Stoke's theorem c) Gauss Divergence theorem
d) convolution theorem

21. The connection between a line integral and a surface integral is known as
a) Green's theorem b) Stoke's theorem c) Gauss Divergence theorem
d) Residue theorem

22. The connection between a surface integral and a volume integral is known as
a) Green's theorem b) Stoke's theorem c) Gauss Divergence theorem
d) Cauchy's theorem

23. Using Gauss divergence theorem, find the value of $\iint_S \vec{r}\,\vec{ds}$ where $\vec{r}$ is the position vector and V is the volume

a) $4V$ b) 0 c) $3V$ d) volume of the given surface

24. If S is any closed surface enclosing the volume V and if $\vec{F} = ax\vec{i} + by\vec{j} + cz\vec{k}$ then the value of $\iint_S \vec{F} \cdot \vec{n}\, dS$ is

a) $abcV$ b) $(a+b+c)V$ c) 0 d) $abc(a+b+c)V$

ANSWERS:

1	b	6	a	11	c	16	c	21	b
2	c	7	a	12	c	17	b	22	c
3	b	8	b	13	a	18	d	23	c
4	a	9	b	14	a	19	c	24	b
5	a	10	a	15	d	20	a		

a