Reg. No ………………………….. Name…………………………………… **26U4177**

B A, BSC, BCOM DEGREE END SEMESTER EXAMINATION – MARCH 2026

UGP (HONS.) SEMESTER – 4: – DISCIPLINE SPECIFIC ELECTIVE

COURSE: 24UMATDSE202 – VECTOR CALCULUS

(For Regular 2024 Admission)

Time: 2 Hours Max. Marks: 70

PART A

Each question carries 2 marks. A maximum of 10 marks can be scored from this part.

1. Write any three properties of vector product of two vectors. (CO 1)
2. If $\vec{a} = 2\hat{\imath} + \hat{\jmath} - 3\hat{k}$, $\vec{b} = 3\hat{\imath} - 2\hat{\jmath} - \hat{k}$. Find the angle between them. (CO 1)
3. Determine the value of λ, so that $\vec{a} = 2\hat{\imath} + \lambda\hat{\jmath} + \hat{k}$, $\vec{b} = 4\hat{\imath} - 2\hat{\jmath} - 2\hat{k}$ are perpendicular. (CO 1)
4. If $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$. Show that div $\vec{r} = 3$. (CO 2)
5. Find curl $\vec{V}$, where $\vec{V} = grad\ (x^3 + y^3 + z^3 - 3xyz)$. (CO 2)
6. If $\overrightarrow{V(t)}$ has a constant magnitude then, what is $\vec{V}.\frac{d\vec{V}}{dt}$? (CO 2)
7. Define surface integral. (CO 3)
8. State Divergence theorem. (CO 4)

PART B

Each question carries 5 marks. A maximum of 30 marks can be scored from this part.

9. Find the volume of tetrahedron having vertices $-(j + k), 4i + 5j + sk, 3i + 9j + 4k$ $and - 4i + 4j + 4k$. Also find the value of s for which these four planes are coplanar. (CO 1)
10. Find the sides and angles of the triangle whose vertices are $\hat{\imath} - 2\hat{\jmath} - 2\hat{k}$, $2\hat{\imath} + \hat{\jmath} - \hat{k}\ and$ $3\hat{\imath} - \hat{\jmath} + 2\hat{k}$. (CO 1)
11. Find the angle between tangents to the curve $\vec{r} = t^2\hat{\imath} + 2t\hat{\jmath} - t^3\hat{k}$ at the point $t = \pm 1$. (CO 2)
12. Show that if $\vec{r} = \vec{a}sin\omega t + \vec{b}cos\omega t$ where $\vec{a}, \vec{b}, \omega$ are constants then $\frac{d^2\vec{r}}{dt^2} = -\omega^2\vec{r}$ and $\vec{r} \times \frac{d\vec{r}}{dt} = -\omega\vec{a} \times \vec{b}$. (CO 2)
13. The acceleration of a particle at time t is given by $\vec{a} = 18\cos 3t\ \vec{\imath} - 8\sin 2t\ \vec{\jmath} + 6t\ \vec{k}$. If the velocity $\vec{v}$ and displacement $\vec{r}$ be zero at t = 0, find $\vec{v}$ and $\vec{r}$ at any point t. (CO 3)

14. Evaluate the line integral $\int_C [(x^2 + xy)\,dx + (x^2+y^2)dy]$ where C is the square formed by the lines $y = \pm 1, x = \pm 1$. (CO 3)

15. Evaluate $\iint_S \vec{F}.\hat{n}\,ds$ over the entire surface of the region above the xy –plane bounded by the cone $x^2 + y^2 = z^2$ and the plane $z = 4$,if $\vec{F} = 4\text{xz}\,\vec{\imath} + (xyz^2)\,\vec{\jmath} + (3z)\,\vec{k}$. (CO 4)

16. Use Greens theorem in the plane to evaluate $\oint_C [(2x^2 - y^2)dx + (x^2 + y^2)dy]$ where C is the boundary in the xy plane of the area enclosed by the x axis and the semi circle $x^2 + y^2 = 1$ in the upper half xy plane. (CO 4)

PART C

Each question carries 15 marks. A maximum of 30 marks can be scored from this part.

17. If $\vec{a} + \vec{b} + \vec{c} = \vec{0}$, Prove that $\vec{a} \times \vec{b} = \vec{b} \times \vec{c} = \vec{c} \times \vec{a}$ (CO 1)

18. Find the directional derivative of the function $f = x^2 - y^2 + 2z^2$ at the point P(1,2,3) in the direction of the line PQ where Q is the point (5,0,4). In what direction it will be maximum? Find also the magnitude of this maximum. (CO 2)

19. If $\vec{A} = 2xz\vec{\imath} - x\vec{\jmath} + y^2\vec{k}$ evaluate $\iiint_V \vec{A}dV$, where V is the region bounded by the surface $x = 0, y = 0, x = 2, y - 6, z = 0 , z = 4$. (CO 3)

20. Verify Divergence theorem for $\vec{F} = (x^2 - yz)\vec{\imath} - (y^2 - xz)\vec{\jmath} - (z^2 - yx)\vec{k}$ taken over the rectangular parallelepiped $0 \le x \le a,\ 0 \le y \le b,\ 0 \le z \le c$. (CO 4)