PARUL UNIVERSITY
Faculty of Engineering & Technology
Department of Applied Sciences and Humanities
1ST SEMESTER B.Tech. PROGRAMME (CSE, IT)
CALCULUS (03019101BS01)
ACADEMIC YEAR – 2025-26

TUTORIAL – 4B VECTOR CALCULUS

1	Evaluate the surface integral $$\iint_S \vec{F}\cdot\hat{n}\,dS$$ where $\vec{F} = (x^2 + y^2)\hat{\imath} - 2x\hat{\jmath} + 2yz\hat{k}$ and S is the surface of the plane 2x+y+z=6, lying in the first octant.
2	Evaluate the surface integral $$\iint_S 15xy\ dS$$ where S is the portion of the plane $x + y + z = 1$, lying in front of the yz-plane.
3	Evaluate the surface integral $$\iint_S \vec{F}\cdot\hat{n}\,dS,$$ where $\vec{F} = z^2\hat{\imath} - 12\hat{\jmath} + 3xy\hat{k}$, and S is the part of the plane $2x + 3y + 6z = 12$, in the first octant.
4	Evaluate the volume integral $$\iiint_V x^2\,y\,dV$$ where V is the region bounded by the planes $4x + 2y + z = 6,\quad x = 0,\quad y = 0,\quad z = 0$.
5	Evaluate the volume integral $$\iiint_V (x^2 + y^2 + z^2)^2\ dV$$ where V is the solid sphere $x^2 + y^2 + z^2 = 4$.
6	Verify Green's theorem for $$\oint_C [(x^2 - 2xy^2)\,dx + (x^2y + 1)\,dy]$$ where C is the boundary of the region enclosed by $y = x^2$and $y = x$.
7	Using Green's theorem, evaluate $$\oint_C (3x^2 - 8y^2)\ dx + (4y - 6xy)\,dy$$ where C is the positively oriented boundary of the region bounded by $y^2 = x$ and $y = x^2$.

8	Using Gauss's divergence theorem, evaluate $$\iint_S \vec{F} \cdot \hat{n}\, dS,$$ where $\vec{F} = x^2\hat{\imath} + y^2\hat{\jmath} + z^2\hat{k}$ and S is the surface of the cube $0 \leq x, y, z \leq 1$.
9	Apply the Gauss divergence theorem to find the outward flux of $\vec{F} = (x + y)\hat{\imath} + (y + z)\hat{\jmath} + (z + x)\hat{k}$ across the surface of the sphere $x^2 + y^2 + z^2 = a^2$.
10	Using Stokes' theorem, evaluate $$\oint_C \vec{F} \cdot d\vec{r}$$ where $\vec{F} = (y - z)\hat{\imath} + (z - x)\hat{\jmath} + (x - y)\hat{k}$ and C is the boundary of the triangle cut from the plane $x + y + z = 1$, by the coordinate planes.