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 - 4A VECTOR CALCULUS

1	If $\vec{r}(t) = (t^2 + 1)\hat{\imath} + (2t - 3)\hat{\jmath} + t^3\hat{k}$, find the velocity and acceleration at t =2.
2	Find the gradient of $\phi = x^2y^3z^4$ at the point (1,1,1) and hence find the normal vector to the surface $x^2y^3z^4 = 1$ at that point.
3	Find the directional derivative of $\phi = xy^2 + yz^3$ at the point (2, -1, 1) in the direction of the line joining the points P (2, -1, 1) and Q (3, 1, 3).
4	For the vector field $\vec{F} = x^2z\,\hat{\imath} - 2y^3z^3\,\hat{\jmath} + xy^2z\,\hat{k}$, find $\vec{\nabla} \cdot \vec{F}$ and determine whether the field is solenoidal.
5	Find the value of the constant a, such that the vector field $\vec{A} = (ax^2y + yz)\,i + (xy^2 + xz^2)\hat{\jmath} + (2xyz - 2x^2y^2)\hat{k}$ is solenoidal.
6	For the vector field $\vec{F} = xz^3\,\hat{\imath} - 2x^2yz\,\hat{\jmath} + 2yz^4\,\hat{k}$, find $\vec{\nabla} \times \vec{F}$ and check whether the field is irrotational.
7	Find the parametric equations of the line joining the points A (1,2,3) and B (4,5,6).
8	Evaluate the line integral $\int_C (3xy\,dx - y^2\,dy)$, where $C: y = 2x^2$, from $(0,0)$ to $(1,2)$.
9	Evaluate the line integral $\int_C (y\,dx + x\,dy)$, where $C: x^2 + y^2 = 1$, is the upper half of the circle from $(-1,0)$ to $(1,0)$.
10	Find the work done by the force $\vec{F} = (x^2 + y)\hat{\imath} + (y^2 + x)\hat{\jmath}$, in moving a particle along the curve $y = x^2$ from the point (0, 0) to (1, 1).