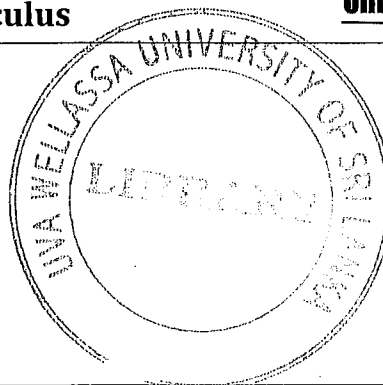


Instructions to candidates

No. of pages : Two (02)
No. of questions : Two (02) Essay questions
Time allocation : One (01) hour
Marks allocation : 100 mark

Answer All Questions



01.

- a) Find the directional derivative of the function $f(x, y, z) = 3xy + z^2$ at the point $(1, -2, 2)$ in the direction from that point to the origin. (mark 20)
- b) Verify the fact that $\text{div}(\text{curl}\vec{F}) = 0$ for the vector field $\vec{F} = yz^2\vec{i} + xy\vec{j} + yz\vec{k}$ (mark 20)

02.

- a) Evaluate $\int_C (2 + x^2y) ds$, where C is the upper half of the unit circle $x^2 + y^2 = 1$. (mark 15)
- b) i.) If $\vec{F}(x, y) = (3 + 2xy)\vec{i} + (x^2 - 3y^2)\vec{j}$, find a function f such that $\vec{F} = \nabla f$. (mark 15)
- ii.) Evaluate the line integral $\int_C \vec{F} \cdot d\vec{r}$, where C is given by $\vec{r}(t) = e^t \sin t \vec{i} + e^t \cos t \vec{j}$,
 $0 \leq t \leq \pi$. (mark 10)
- c) Use the Stoke's Theorem to evaluate $\iint_S \text{curl } \vec{F} \cdot ds$, where $\vec{F}(x, y, z) = xz\vec{i} + yz\vec{j} + xy\vec{k}$ and S is the part of the sphere $x^2 + y^2 + z^2 = 4$ that lies inside the cylinder $x^2 + y^2 = 1$ above the xy - plane. (mark 20)