K26FY1382 Pages: 2 Reg No:................

Name:................

Second Semester FYUGP Degree (Reg/Sup/Imp) Examination April 2026

KU2DSCMAT116 - MULTIVARIABLE CALCULUS

2024 Admission onwards

Time : 2 hours Maximum Marks : 70

Section A

Answer any 6 questions. Each carry 3 marks.

1. Find the level curves $f(x, y) = 0$ where $f(x, y) = x + y - 1$.
2. Find the domain for the function $f(x, y) = \dfrac{(x-1)(y+2)}{(y-x)(y-x^3)}$.
3. Define the Laplacian operator Δ.
4. Define divergence of a vector field.
5. Find the curl of the vector function $[xy, 3zy, x]$
6. Evaluate $\displaystyle\int_{\pi}^{2\pi}\int_{0}^{\pi} (\sin x + \cos y)\, dx\, dy$.
7. Evaluate $\displaystyle\int_{0}^{2}\int_{-1}^{1} (x - y)\, dy\, dx$.
8. Change the order of the double integral $\displaystyle\int_{0}^{2}\int_{y-2}^{0} dx\, dy$.

Section B

Answer any 4 questions. Each carry 6 marks.

9. If $f(x, y, z)$ and $g(x, y, z)$ are scalar functions, prove that $\nabla\left(\dfrac{f}{g}\right) = \left(\dfrac{1}{g^2}\right)(g\nabla f - f\nabla g)$.
10. Define gradient of a scalar differentiable function $f(x, y, z)$. Using the idea of gradient, find the unit normal to the surface $z^2 = 2x^2 + 3y^2$ at the point $(1, 0, \sqrt{2})$.
11. If $\mathbf{F} = [x + y + 1, 1, -(x + y)]$, show that $\mathbf{F}.\text{curl}(\mathbf{F}) = 0$.
12. Find the volume of the region bounded above by the ellipitical paraboloid $z = 10 + x^2 + 3y^2$ and below by the rectangle $R : 0 \le x \le 1, -1 \le y \le 2$.

13. Calculate $\displaystyle\int_{0}^{1}\int_{0}^{3-3x}\int_{0}^{3-3x-y} dz\, dy\, dx$.
14. Evaluate the integral $\displaystyle\int_{0}^{1}\int_{0}^{1}\int_{0}^{1} (x^2 + y^2 + z^2)\, dz\, dy\, dx$.

Section C

Answer any 2 questions. Each carry 14 marks.

15. (a) Find the line integral of $f(x, y, z) = x + y + z$ over the straight-line segment from $(1, 2, 3)$ to the point $(0, -1, 1)$.
    (b) Integrate $f(x, y, z) = -\sqrt{x^2 + z^2}$ over the circle $\mathbf{r}(t) = (a\cos t)\mathbf{j} + (a\sin t)\mathbf{k}$, $0 \le t \le 2\pi$.
16. Find the area of the surface cut from the bottom of the paraboloid $x^2 + y^2 - z = 0$ by the plane $z = 4$.
17. (a) Find f_{xx}, f_{yy} and f_{xy} if $f(x, y) = y\sin xy$.
    (b) Find f_x and f_y if $f(x, y) = \dfrac{2xy}{y + \cos x}$.