

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 $f(x, y) = \frac{(x-1)(y+2)}{(y-x)(y-x^3)}$.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 $\int_{\pi}^{2\pi} \int_0^{\pi} (\sin x + \cos y) dx dy$.7. Evaluate $\int_0^2 \int_{-1}^1 (x-y) dy dx$.8. Change the order of the double integral $\int_0^3 \int_{y-2}^0 dx dy$.

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 $\nabla \left(\frac{f}{g} \right) = \left(\frac{1}{g^2} \right) (g \nabla f - f \nabla g)$.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 $\mathbf{F} \cdot \text{curl}(\mathbf{F}) = 0$.12. Find the volume of the region bounded above by the elliptical paraboloid $z = 10 + x^2 + 3y^2$ and below by the rectangle $R: 0 \leq x \leq 1, -1 \leq y \leq 2$.

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13. Calculate $\int_0^1 \int_0^{3-3x} \int_0^{3-3x-y} dz dy dx$.14. Evaluate the integral $\int_0^1 \int_0^1 \int_0^1 (x^2 + y^2 + z^2) dz dy dx$.

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 $\mathbf{r}(t) = (a \cos t)\mathbf{j} + (a \sin t)\mathbf{k}$, $0 \leq t \leq 2\pi$.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 $f(x, y) = \frac{2xy}{y + \cos x}$.