QP Code: U25C054

Reg. No : .....

Name : .....

ST MARY'S COLLEGE (AUTONOMOUS), THRISSUR-20

III SEMESTER (FYUGP) DEGREE EXAMINATIONS, OCTOBER 2025

B. Sc. Mathematics

MAT3CJ201 : MULTI VARIABLE CALCULUS

2024 Admission Onwards

(Credits: 4)

Time: 2 Hours **Maximum Marks: 70**

Section A

*Answer **all**. Each question carries **3** Marks* ***(Ceiling: 24 Marks)***

1. Graph the set of points whose polar coordinates satisfy the condition $\frac{2\pi}{3} \leq \theta \leq \frac{5\pi}{6}$
2. Replace the following equation by the equivalent cartesian equation $r = \frac{4}{2\cos\theta - \sin\theta}$
3. Find the parametric equation for the line through $P(1, 2, -1)$ and $Q(-1, 0, 1)$
4. Find the domain, range and level curve of the real valued function $f(x, y) = \sqrt{9 - x^2 - y^2}$
5. Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$ of the function $f(x, y) = \frac{1}{x+y}$
6. Identify all the points in $\mathbb{R}^2$ at which the function $f(x, y) = \frac{x+y}{x-y}$ is continuous
7. Find the gradient of the function $f(x, y) = y - x^2$ at the point $(-1, 0)$
8. Find the derivative of $f(x, y) = 2xy - 3y^2$ at the point $(5, 5)$ in the direction of $A = 4i + 3j$
9. Evaluate the integral $\int_{-1}^{0}\int_{-1}^{1} (x + y + 1)\, dx\, dy$
10. Sketch the region $R : 0 \leq x \leq 1, 0 \leq y \leq 2$

Section B

*Answer **all**. Each question carries **6** Marks* ***(Ceiling: 36 Marks)***

11. Find a parametric equation for the line in which the planes $3x - 6y - 2z = 3$ and $2x + y - 2z = 2$ intersect.
12. Find the point in which the line $x = 1 + 2t, y = 1 + 5t, z = 3t$ meets the plane $x + y + z = 2$
13. Find the linearization of $f(x, y) = x^2 + y^2 + 1$ at the points $(0, 0)$ and $(1, 1)$

Turn Over

14. Show that the function $f(x,y) = \frac{x^4 - y^2}{x^4 + y^2}$ has no limit as (x,y) approaches $(0,0)$

15. Find an equation for the tangent plane and normal line of the surface $f(x,y,z) = 2z - x^2$ at the point $(2,0,2)$

16. Find the local extreme values of $f(x,y) = x^2 - 4xy + y^2 + 6y + 2$

17. Find the average value of $f(x,y) = x\cos xy$ over the rectangle. $R : 0 \le x \le \pi, 0 \le y \le 1$

18. Evaluate $\iint_R e^{x^2+y^2}\, dy\, dx$ where R is the semicircular region bounded by x axis and the curve $y = \sqrt{1 - x^2}$

Section C

*Answer **any one**. Each question carries **10** Marks* ***(1x10=10marks)***

19. Express $\frac{\partial w}{\partial r}$ and $\frac{\partial w}{\partial s}$ in terms of r and s if $w = x + 2y + z^2$, $x = \frac{r}{s}$, $y = r^2 + \ln s$ and $z = 2r$

20. A thin plate covers the triangular region bounded by x axis and the lines $x = 1$ and $y = 2x$ in the first quadrant. The plate's density at the point (x,y) is $\delta(x,y) = 6x + 6y + 6$. Find the center of mass and moment of inertia about x axis of the plate.

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