24U311 (Pages: 2) Name : .....

Reg. No : .....

THIRD SEMESTER UG DEGREE EXAMINATION, NOVEMBER-2025

(FYUGP)

CC24UMAT3CJ201 - MULTIVARIABLE CALCULUS

(B.Sc. Mathematics / Mathematics & Computer Science Double Main - Major Course)

(2024 Admission - Regular)

Time: 2.0 Hours Maximum: 70 Marks

Credit: 4

Part A (Short answer questions)

Answer ***all*** questions. Each question carries 3 marks.

1. Find the points in which the line $x = -1 + 3t \ y = -2 \ z = 5t$ meet the plane $2x - 3z = 7$ [Level:2] [CO1]
2. Give parametrization of the circle $x^2 + y^2 = a^2$ in the first quadrant. [Level:2] [CO1]
3. Find $\frac{\partial f}{\partial z}$ if $f(x, y, z) = x \sin(y + 3z)$. [Level:2] [CO2]
4. At what points (x, y) in the plane is the function $f(x, y) = \sin(x + y)$ continuous? [Level:2] [CO2]
5. Find $\frac{dy}{dx}$ if $x^2 + \sin y - 2y = 0$. [Level:2] [CO2]
6. Find the local extreme values of $f(x, y) = x^2 + xy + y^2 + 3x - 3y + 4$. [Level:2] [CO3]
7. Find the tangent plane and normal line of the surface $f(x, y, z) = 2z - x^2 = 0$ at the point $P_0(2, 0, 2)$. [Level:2] [CO3]
8. Calculate $\int_0^3 \int_0^2 (4 - y^2)\, dydx$ [Level:2] [CO4]
9. Find $\int_0^1 \int_0^1 \int_0^1 dxdydz$ [Level:2] [CO5]
10. Evaluate $\int_0^1 \int_{1-x}^{1-x^2} dydx$ [Level:1] [CO4]

(Ceiling: 24 Marks)

Part B (Paragraph questions/Problem)

Answer ***all*** questions. Each question carries 6 marks.

11. a) Find the Cartesian coordinates of the points $P(0, \pi/2)$ and $Q(\sqrt{2}, \pi/4)$. [Level:3] [CO1]

    b) Plot the point $(2, \pi/2)$, then find all the polar coordinates of the point.

12. a) Define Spherical coordinates and cylindrical coordinate [Level:3] [CO1]

    b) Find cylindrical and sperical coordinate corresponding to the rectangular coordinate (1.0,0)

c) Find Rectangular and sperical coordinate corresponding to the cylindrical coordinate $(1, \frac{\pi}{2}, 1)$

13. Define graph and level curve of a function f. Graph $f(x, y) = 100 - x^2 - y^2$ and plot the level curves $f(x, y) = 51$, and $f(x, y) = 75$ in the domain of f in the plane. [Level:3] [CO2]

14. Find the linearization of $f(x, y) = x^2 + y^2 + 1$ at the point $(0, 0)$. [Level:3] [CO2]

15. Find the derivative of $f(x, y) = xe^y + \cos(xy)$ at $P_0(2, 0)$ in the direction of $A = 3i - 4j$. [Level:2] [CO3]

16. Find the absolute maximum and minimum values of $f(x, y) = 2 + 2x + 2y - x^2 - y^2$ on the triangular plate in the first quadrant bounded by the lines $x = 0,\ y = 0,\ y = 9 - x$. [Level:3] [CO3]

17. Find the average value of $F(x, y, z{=}x^2 + 9$ over the cube in the first octant by the coordinate planes and the planes $x = 2$,$y = 2$ and $z = 2$. [Level:3] [CO5]

18. Find the polar moment of inertia about the origin of a thin plate od density $\delta(x, y) = 1$ bounded by the quarter circle $x^2 + y^2 = 1$ in the quadrant [Level:2] [CO4]

(Ceiling: 36 Marks)

Part C (Essay questions)

Answer any ***one*** question. The question carries 10 marks.

19. The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse. Find the points on the ellipse that lie closest to and farthest from the origin. [Level:3] [CO3]

20. A thin plate covers the triangular region bounded by the y axis and the line $y = 1$ and $y = x$ in the first quadrant. The plates density at the point (x, y) is $\delta(x, y){=}\ 4x + 2y + 1$. Find the plates mass, first moments, center of mass. [Level:3] [CO4]

(1 × 10 = 10 Marks)

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