

QP CODE: D3BMT2402	(Pages: 2)	Reg. No	:
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THIRD SEMESTER FYUGP EXAMINATION, NOVEMBER 2025

Discipline Specific Core (DSC) Courses - Major

MAT3CJ201 : Multivariable Calculus

(Credits: 4)

Time: 2 Hours

Maximum Marks: 70

Section A

Answer the following questions. Each carries 3 marks (Ceiling: 24 marks)

1. Find the distance from the point $(2, 1, 3)$ to the line $x = 2 + 2t, y = 1 + 6t, z = 3$.	BL3 CO1
2. Draw the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$.	BL3 CO1
3. Find an equation for the circular cylinder $9x^2 + 9y^2 = 16$ in cylindrical coordinates.	BL2 CO1
4. Find $\frac{\partial f}{\partial x}$ and $\frac{\partial f}{\partial y}$, if: a) $f(x, y) = 2x^2 - 3y - 4$. b) $f(x, y) = (x^2 - 1)(y + 2)$	BL1 CO2
5. a) Define domain and range of a function of two variables. b) Find domain and range of $w = \frac{1}{xy}$.	BL2 CO2
6. Find the directional derivative of $f(x, y) = x \sin^2 y$ at the point $P(-1, \pi/4)$ in the direction of $\mathbf{v} = -2\mathbf{i} + 3\mathbf{j}$.	BL3 CO2
7. State Lagrange Theorem on Multipliers.	BL1 CO2
8. Use double integrals to find the area bounded by $y = x$, and $y = x^2$ in the first quadrant.	BL1 CO3
9. Evaluate $\int_1^2 \int_0^4 (2x - y^2) dy dx$.	BL2 CO2
10. Evaluate $\int_0^1 \int_0^1 \int_0^1 (x + y) dx dy dz$.	BL3 CO3

Section B

Answer the following questions. Each carries 6 marks (Ceiling: 36 Marks)

11. Let $x = t, y = \sqrt{1 - t^2}, -1 \leq t \leq 0$ be parametrization for the motion of a particle in the xy-plane. Identify the particle's path by finding a Cartesian equation for it. Graph the Cartesian equation. Indicate the portion of the graph traced by the particle and the direction of motion.	BL3 CO1
12. a) Replace the Polar equation $r = \frac{5}{\sin \theta - 2 \cos \theta}$ by equivalent Cartesian equation. b) Replace the Cartesian equation $x^2 + xy + y^2 = 1$ by equivalent Polar equation.	BL2 CO1
13. Show that $f(x, y) = \begin{cases} \frac{2xy}{x^2 + y^2}, & (x, y) \neq (0, 0) \\ 0, & (x, y) = (0, 0) \end{cases}$ is continuous at every point except the origin.	BL1 CO2
14. Find the linearization of $f(x, y) = x^2 + y^2 + 1$ at the point $(1, 1)$.	BL2 CO2

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15. Find the local extreme values of $f(x, y) = xy$.	BL3	CO2
16. Find local extreme values of $f(x, y) = xy$	BL2	CO2
17. Sketch the region of integration and evaluate the double integral $\int_1^{\ln 8} \int_0^{\ln y} e^{x+y} dx dy$.	BL3	CO2
18. Evaluate the following using polar coordinates.	BL3	CO3
a) $\int_0^1 \int_0^{\sqrt{1-y^2}} (x^2 + y^2) dx dy$		
b) $\int_{-1}^1 \int_{-\sqrt{1-y^2}}^{\sqrt{1-y^2}} (x^2 + y^2) dx dy$		

Section C

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

19. a) Apply chain rule to find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ for $z = x^2 + y^2$, where $x = u \sin v$ and $y = u - 2v$.	BL3	CO2
b) Find the higher - order partial derivatives $\frac{\partial^2 z}{\partial x \partial y}$, $\frac{\partial^2 z}{\partial x^2}$, $\frac{\partial^2 z}{\partial y^2}$ for the function $z = \sin x + \tan y$.		
20. Find the absolute maximum and minimum values of $f(x, y, z) = 2x + y$ subject to the constraints $x + y + z = 1$ and $y^2 + z^2 = 9$.	BL3	CO2

CO : Course Outcome

BL : Bloom's Taxonomy Levels (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, Create)

5 – Evaluate, 6 –