QP CODE: D3BMT2404	(Pages: 2)	Reg. No	:	....
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THIRD SEMESTER FYUGP EXAMINATION, NOVEMBER 2025

Discipline Specific Core (DSC) Course - Minor

MAT3MN201 : Calculus of Several Variables

(Credits: 4)

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

Section A

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

1.	Show that $\lim\limits_{(x,y)\to(0,0)} \frac{x^2-y^2}{x^2+y^2}$ does not exist.	BL2	CO3
2.	Evaluate $\int_1^2 \int_0^1 3x^2y\,dx\,dy$	BL2	CO2
3.	Find the Jacobian of the transformation T defined by the equations $x = u^2 + 2v, y = 3u + v$	BL2	CO2
4.	Write three line integrals that gives the area of a region bounded by a piecewise smooth curve C.	BL2	CO3
5.	Let $w = x^2y + y^2z^3$, where $x = r\cos s, y = r\sin s,$ and $z = re^s$. Find the value of $\frac{\partial w}{\partial s}$ when $r = 1$ and $s = 0$.	BL2	CO3
6.	Evaluate $\int_C 2xyds$, where C is the line segment joining (-2,1) to (1,3).	BL2	CO2
7.	Find the mass of lamina occupying a rectangular region R with vertices $(0,0),(3,0),(3,1)$ and $(0,1)$ if the mass density at a point (x,y) in R is $\rho(x,y) = x^2 + y^2$	BL2	CO2
8.	Find a parametric representation for the cone $x = \sqrt{y^2 + z^2}$	BL2	CO3
9.	A vector field F in R^2 is defined by $F(x,y) = xi + yj$. Describe F, and sketch a few vectors representing the vector field.	BL2	CO1, CO3
10.	Find the relative extrema of $f(x,y) = x^3 + y^2 - 2xy + 7x - 8y + 2$.	BL2	CO3

Section B

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

11.	Let $f(x,y) = 4 - 2x^2 - y^2$. Find the slope of the tangent line at the point $(1,1,1)$ on the curve formed by the intersection of the surface $z = f(x,y)$ and (i) the plane $y = 1$. (ii) the plane $x = 1$.	BL2	
12.	Sketch the curve defined by the vector function $r(t) = 3\,i + t\,j + (4 - t^2)\,k, -2 \le t \le 2$. **(PTO)**	BL3	CO1

13.	Evaluate $\iiint_T x\,dV$, where T is the part of the region in the first octant lying inside the sphere $x^2+y^2+z^2=1$	BL2	CO2
14.	Evaluate $\iint_S xy\,dS$, where S is the part of the plane $3x+2y+z=6$ that lies in the first octant.	BL3	CO2, CO3
15.	Let $F(x,y)=2xyi+x^2j$ be a force field. (i) Prove that F is conservative by showing that it is the gradient of the potential function $f(x,y)=x^2y$. (ii) Use the Fundamental theorem for line integrals to evaluate $\int_C F.dr$, where C is any piecewise-smooth curve joining the point A(-1,2) to the point B(3,1).	BL2	CO1, CO3
16.	Evaluate $\iint_S curl\ F.dS$, where $F(x,y,z)=xyzi+2xj+tan^{-1}y^2k$ and S is the part of the hemisphere $z=\sqrt{4-x^2-y^2}$ lying inside the cylinder $x^2+y^2=1$ and oriented with normal pointing upward.	BL3	CO2, CO3
17.	Find the directional derivative of the function $f(x,y)=(x+1)e^y$ at the point $P(3,0)$ in the direction of the unit vector that makes an angle $\theta=\frac{\pi}{2}$ with the positive x-axis. $f(x,y)=(x+1)e^y;\ P(3,0),\ \theta=\frac{\pi}{2}.$	BL2	CO1, CO3
18.	Find the area of the surface S .Where S is the part of the surface $z=\frac{1}{2}x^2+y$ that lies above the triangular region R in the xy-plane with vertices $(0,0),(1,0)$ and $(1,1)$	BL2	CO2
	Section C		
	Answer any one question. Each carries 10 marks (1 x 10 = 10 Marks)		
19.	Sketch the level curve of the function f that passes through the point P and find the gradient of f at P. (i) $f(x,y)=4x^2+y^2;\ P(\frac{\sqrt{3}}{2},1)$ (ii) $f(x,y)=x^2+y;\ P(1,3)$	BL2	CO1, CO3
20.	Verify the Divergence Theorem for the given vector field $F(x,y,z)=xi+yj+zk$ and the region T is the cube bounded by the planes $x=0,x=1,y=0,y=1,z=0,$ and $z=1$	BL4	CO2, CO3
	CO : Course Outcome		
	BL : Bloom's Taxonomy Levels (1 – Remember, 2 – Understand, 3 – Apply, 4 – Analyse, 5 – Evaluate, 6 – Create)		