QP Code: U25C029

Reg. No : ....
Name : ....

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

III SEMESTER (FYUGP) DEGREE EXAMINATIONS, OCTOBER 2025
MAT3MN203 : MATRIX ALGEBRA AND VECTOR 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. Find $\mathbf{a} \times \mathbf{b}$ if $\mathbf{a} = i - 3j + k$ and $\mathbf{b} = 2i + 4k$.
2. Find angle between the vectors $2i + 4j$ and $-i - j + 4k$
3. If $\mathbf{a} = i + j + k, \mathbf{b} = 2i - j + 3k$ find $||\mathbf{a} + \mathbf{b}||$.
4. Find $r'(t)$ and $r''(t)$ for the vector function $r(t) = (t\cos t - \sin t)\, i + (t + \cos t)\, j$
5. Find the first partial derivatives of the function $w = xy\ln(xz)$
6. Verify that $K = \begin{bmatrix} 2+\sqrt{2} \\ 2 \end{bmatrix}$ is an eigenvector of the matrix $A = \begin{bmatrix} 2 & -1 \\ 2 & -2 \end{bmatrix}$. Give the corresponding eigen value.
7. Let $A = \begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$ and $B = \begin{bmatrix} -2 & 3 \\ 5 & 7 \end{bmatrix}$, find a) $A + B^T$ b) $2A^T - B^T$.
8. Evaluate $\int_C xy^2 dy$ on the quarter- circle C defined by $x = 4cost, y = 4sint, 0 \le t \le \frac{\pi}{2}$.
9. Evaluate the given partial integral; $\int_0^{2x} \frac{xy}{x^2+y^2} dy$.
10. Sketch the region of integration for the given iterated integral; $\int_0^2 \int_1^{2x+1} f(x,y)dydx$.

Section B

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

11. Find vector equation, parametric equation and symmetric form for the line through the points $(0, 4, 5)$ and $(2, 6, 3)$.

Turn Over

12. Find an equation of the plane that contains the point $(5,1,3)$ and is perpendicular to the vector $2i-3j+4k$

13. Find parametric equations and symmetric equations for the normal line to the surface $z=4x^2+9y^2+1$ at the point $(\frac{1}{2},\frac{1}{3},3)$

14. Find $D_u f(x,y)$ where $f(x,y)=3x-y^2$ and u makes an angle $\theta=45^\circ$ with the positive x-axis.

15. Use Gauss-Jordan elimination to solve the system $\begin{array}{rcrcrcl} 2x_1 & + & 2x_2 & & & = & 0 \\ -2x_1 & + & x_2 & + & x_3 & = & 0 \\ 3x_1 & + & & & x_3 & = & 0 \end{array}$

16. Determine whether the set of vectors $u_1=(2,6,3), u_2=(1,-1,4), u_3=(3,2,1), u_4=(2,5,4)$ in R^3 is linearly dependent or linearly independent.

17. Evaluate the double integral $\iint_R (x+1)dA$ over the region Rin the first quadrant bounded by the graphs of $y=x, x+y=4$ and $x=0$.

18. Evaluate the given iterated integral: $\int_0^{\sqrt{2}}\int_{\sqrt{y}}^{2}\int_0^{e^{x^2}} dzdxdy.$

Section C

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

19. (a) Find the curl and the divergence of the vector field $F(x,y,z)=xz\,i+yz\,j+xy\,k$
(b) Use the Chain Rule to find the partial derivatives $\frac{\partial z}{\partial u},\frac{\partial z}{\partial v}$ if $z=\frac{x-y}{x+y}, x=u^3, y=u-v^2$

20. Find the eigenvalues and eigenvectors of $A=\begin{bmatrix}4 & 8\\ 0 & -5\end{bmatrix}$.

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