

THE KAVERY ENGINEERING COLLEGE*(An Autonomous Institution)***B.E/B.TECH DEGREE END SEMESTER THEORY EXAMINATIONS, NOV/DEC 2025***First Semester**Agricultural Engineering***MA3151/UMAT24102 – Matrices and Calculus****(Common to all Branches)****Regulations – 2021/2024****Duration : 3 Hrs****Maximum : 100 Marks****PART – A (ANSWER ALL QUESTIONS) (Marks 10*2=20)**

Q.No	Questions	BLT	CO	Marks
1.	The Eigenvalues and the corresponding Eigenvectors of a 2×2 matrix is given by $\lambda_1=8$; $x_1 = \begin{bmatrix} 1 \\ 1 \end{bmatrix}$ and $\lambda_2=4$; $x_2 = \begin{bmatrix} 1 \\ -1 \end{bmatrix}$. Identify the corresponding matrix.	L3	1	2
2.	Solve the matrix for the quadratic form $2x_1^2 - 2x_2^2 + 4x_3^2 + 2x_1x_2 - 6x_1x_3 + 6x_2x_3$	L3	1	2
3.	Find the limit $\lim_{x \rightarrow 1} \frac{x^2 - 4x}{x^2 - 3x - 4}$	L3	2	2
4.	Find the point of inflection of $f(x) = x^3 - 9x^2 + 7x - 6$	L3	2	2
5.	Prove that $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$ if $f(x, y) = x^3 + y^3 + z^3 + 3xyz$	L3	3	2
6.	If $u = \frac{y^2}{x}$, $v = \frac{x^2}{y}$ find $\frac{\partial(u, v)}{\partial(x, y)}$	L1	3	2
7.	Evaluate $\int \frac{\tan x}{\sec x + \tan x} dx$	L5	4	2
8.	Analyze whether the integral is divergent or convergent if $\int_0^\infty \frac{dx}{x^2 + 4}$	L4	4	2
9.	Develop the region of integration in $\int_0^1 \int_x^1 f(x, y) dy dx$	L3	5	2
10.	Transform the double integral $\int_0^2 \int_y^2 \frac{x dx dy}{x^2 + y^2}$ to polar coordinates.	L4	5	2

PART – B (ANSWER ALL QUESTIONS) (Marks 5*16 = 80)

Q.No	Questions	BLT	CO	Marks
11.	a i Construct the Eigen values and Eigen vectors of the matrix $A = \begin{bmatrix} 2 & 2 & 0 \\ 2 & 1 & 1 \\ -7 & 2 & -3 \end{bmatrix}$	L3	1	8
	ii Apply C-H theorem find A^4 if $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$	L3	1	8

Or

- b Reduce the quadratic form $6x^2 + 3y^2 + 3z^2 - 4xy - 2yz + 4xz$ to canonical form through an orthogonal transformation. Also find its nature, rank, index and signature. L3 1 16
12. a i For what values of a and b is, L3 2 8
- $$f(x) = \begin{cases} -2 & x \leq -1 \\ ax - b, & -1 < x < 1 \\ 3 & x \geq 1 \end{cases}$$
- continuous at every x .

- ii Find $\frac{dy}{dx}$ if $x^2 + y^2 = 25$ and also find an equation of the tangent line to the curve at the point (3,4). L3 2 8

Or

- b i Find the differential coefficients of $\frac{(a-x)^2(b-x)^3}{(c-2x)^3}$ L3 2 6
- ii Find the intervals on which $f(x) = -x^3 + 12x + 5$; $-3 \leq x \leq 3$ is increasing and decreasing. Where does the function assume extreme values? What are those values? L3 2 10
13. a i If $u = \sin^{-1}\left[\frac{x^3-y^3}{x+y}\right]$ then Show that $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 2 \tan u$. L2 3 6
- ii Give the transformations $u = e^x \cos y$ & $v = e^x \sin y$ and that f is a function of u and v and also of x and y show that $\frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2} = (u^2 + v^2) \left(\frac{\partial^2 f}{\partial u^2} + \frac{\partial^2 f}{\partial v^2} \right)$ L2 3 10

Or

- b i Illustrate the extreme values of $f(x, y) = x^4 + y^4 - 2x^2 + 4xy - 2y^2$. L2 3 8
- ii Expand $e^x \log(1 + y)$ in powers of x and y up to third degree term. L2 3 8
14. a i Evaluate $\int x^2 e^x dx$ by using integration by parts. L5 4 8
- ii Evaluate $\int \frac{3x+1}{(x-1)^2(x+3)} dx$, use partial fraction technique. L5 4 8

Or

- b i Evaluate $\int \frac{2x+3}{x^2+x+1} dx$ L5 4 8
- ii Evaluate $\int \frac{dx}{\sqrt{3x-x^2-2}}$ L5 4 8

15. a i Change the order of integration in $\int_0^1 \int_{x^2}^{2-x} xy dy dx$ and hence evaluate it. L3 5 8

ii Identify the area between the curves $y^2 = 4x$ and $x^2 = 4y$. L3 5 8

Or

b i Solve $\int_0^{2a} \int_0^x \int_y^x xyz \, dz dy dx$. L3 5 8

ii Find the volume of the region bounded by the paraboloid $z = x^2 + y^2$ and the plane $z = 4$. L3 5 8