Roll No. | | | | | | | | | | |

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)
B.E. / B. Tech. (Full Time) – END SEMESTER EXAMINATIONS, APRIL / MAY 2025

ELECTRONICS AND COMMUNICATION ENGINEERING

First Semester

MA5158 & ENGINEERING MATHEMATICS I

(Regulation 2019)

Time: 3hrs Max.Marks : 100

CO 1	Use the matrix algebra methods for solving practical problems.
CO 2	Apply differential calculus tools in solving various application problems.
CO 3	Able to use differential calculus ideas on several variable functions.
CO 4	Apply different methods of integration in solving practical problems.
CO 5	Apply multiple integral ideas in solving areas, volumes and other practical problems.

BL – Bloom's Taxonomy Levels

(L1 - Remembering, L2 - Understanding, L3 - Applying, L4 - Analysing, L5 - Evaluating, L6 - Creating)

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1	The product of two eigenvalues of the matrix $A = \begin{pmatrix} 1 & 0 & 0 \\ 0 & 3 & -1 \\ 0 & -1 & 3 \end{pmatrix}$ is 8. Find the eigenvalues of A^{-1}.	2	1	L2
2	Find the index and signature of the quadratic form $x_1^2 + 2x_2^2 - 3x_3^2$.	2	1	L2
3	If $f(1) = 10$ and $f'(x) \geq 2$ for $1 \leq x \leq 4$, how small can $f(4)$ possibly be?	2	2	L2
4	Evaluate: $\lim_{x \to 5} (2x^2 - 3x + 4)$.	2	2	L2
5	Find the value of $\frac{du}{dt}$ given $u = y^2 - 4ax, x = at^2, y = 2at$.	2	3	L2
6	If $x = r\cos\theta$ and $y = r\sin\theta$, compute $\frac{\partial(x,y)}{\partial(r,\theta)}$.	2	3	L2
7	Use properties of integrals to estimate the lower and upper bounds of the integral $\int_0^1 e^{-x^2}\, dx$.	2	4	L2
8	Find $\int_2^5 \frac{1}{\sqrt{x-2}}\, dx$.	2	4	L2
9	Evaluate : $\int_0^a \int_0^b \int_0^c (x + y + z)\, dzdydx$.	2	5	L2
10	Sketch the region of the integration in the integral $\int_0^{\frac{\pi}{2}} \int_{a\cos\theta}^{a} f(r,\theta) drd\theta$.	2	5	L2

PART- B (5 x 13 = 65 Marks)

(Restrict to a maximum of 2 subdivisions)

Q. No	Questions	Marks	CO	BL
11(a)	Reduce the quadratic form $x_1^2 + 2x_2^2 + x_3^2 - 2x_1x_2 + 2x_2x_3$ to the canonical form through an orthogonal transformation. Also find the nature of the quadratic form.	13	1	L3
	OR			
11 (b) (i)	Verify Cayley-Hamilton Theorem for the matrix $A = \begin{pmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{pmatrix}$. Hence find A^{-1}.	7	1	L3
(ii)	Find the eigen values of A and hence find A^n(n is a positive integer), given that $A = \begin{pmatrix} 1 & 2 \\ 4 & 3 \end{pmatrix}$.	6	1	L3

12 (a) (i)	Prove that the equation $x^3 + x - 1 = 0$ has exactly one real root.	7	2	L4
(ii)	Test the continuity and differentiability of the function $f(x) = \|x - 2\|$ at $x = 2$.	6	2	L4
	OR			
12 (b) (i)	Discuss the curve $y = x^4 - 4x^3$ with respect to concavity, points of inflection, and local maxima and minima.	7	2	L4
(ii)	Find the horizontal and vertical asymptotes of the graph of the function $f(x) = \frac{\sqrt{2x^2+1}}{3x-5}$.	6	2	L4
13(a) (i)	Find the Taylor's series expansion of $\log(1 + x + y)$ near the point $(0,0)$ upto third-degree terms.	7	3	L3
(ii)	If $u = \sin^{-1}\frac{x}{y} + \tan^{-1}\frac{y}{x}$, find $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y}$ and verify Euler's theorem.	6	3	L4
	OR			
13 (b) (i)	Find the percentage error in the area of ellipse if one per cent error is made in measuring the major and minor axes.	7	3	L4
(ii)	Determine whether $u = y + z, v = x + 2z^2, w = x - 4yz - 2y^2$ are functionally related, if so find the relation between them.	6	3	L3
14 (a) (i)	Find $\int \tan^6 x \sec^4 x \, dx$.	7	4	L3
(ii)	Evaluate $\int \frac{\sqrt{x^2-9}}{x^3} dx$.	6	4	L3
	OR			
14 (b)(i)	Evaluate $\int e^{2\theta} \sin 3\theta \, d\theta$	7	4	L3
(ii)	Find $\int \frac{x^2+2x-1}{2x^3+3x^2-2x} dx$.	6	4	L3
15(a)(i)	Change the order of integration in $\int_0^1 \int_y^{2-y} xy \, dxdy$ and then evaluate it.	7	5	L3
(ii)	Find the area that lies inside the cardioid $r = a(1 + \cos\theta)$ and outside the circle $r = a$ using double integration.	6	5	L3
	OR			
15 (b)(i)	Express the volume of the sphere $x^2 + y^2 + z^2 = a^2$as a volume integral and hence evaluate it.	7	5	L3
(ii)	Find the area bounded by the parabolas $y^2 = 4 - x$ and $y^2 = x$ by double integration.	6	5	L3

PART- C (1 x 15 = 15 Marks)

(Q.No.16 is compulsory)

Q. No	Questions	Marks	CO	BL
16(i)	Find the dimensions of the rectangular box, open at the top, of maximum capacity whose surface is 432 sq. cm.	8	3	L6
(ii)	Find an equation of the tangent to the circle $x^2 + y^2 = 25$ at the point (3,4).	7	2	L6