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

ANNA UNIVERSITY (UNIVERSITY DEPARTMENTS)

B.E. (Full Time) - END SEMESTER EXAMINATIONS, APRIL / MAY 2024

I Semester

MA5158 & ENGINEERING MATHEMATICS - I

(Regulation 2019)

Time: 3hrs Max.Marks: 100

CO 1	To develop the use of matrix algebra techniques that is needed by engineers for practical applications.
CO 2	To familiarize the students with differential calculus.
CO 3	To familiarize the student with functions of several variables. This is needed in many branches of engineering.
CO 4	To make the students understand various techniques of integration.
CO 5	To acquaint the student with mathematical tools needed in evaluating multiple integrals and their applications.

BL – Bloom's Taxonomy Levels

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

PART- A (10 x 2 = 20 Marks)

(Answer all Questions)

Q. No	Questions	Marks	CO	BL
1.	One of the eigenvalues of $\begin{pmatrix} 7 & 4 & 4 \\ 4 & -8 & -1 \\ 4 & -1 & -8 \end{pmatrix}$ is -9, find the other two eigenvalues.	2	1	L1
2.	Determine λ so that $\lambda(x^2+y^2+z^2)+2xy-2xz+2zy$ is positive definite.	2	1	L2
3.	Find $\lim_{x\to 0} x^2 \sin\left(\frac{1}{x}\right)$.	2	2	L2
4.	Find the points on the curve $y = x^4 - 6x^2 + 4$ where the tangent line is horizontal.	2	2	L1
5.	If $u = \frac{y^2}{x}$, $v = \frac{x^2}{y}$, then find $\frac{\partial(u,v)}{\partial(x,y)}$.	2	3	L1
6.	Find the stationary point of $f(x,y) = x^2 + y^2 + 6x + 12$.	2	3	L2
7.	Find the derivative of $y(x) = \int_1^{e^x} \log t \, dt$.	2	4	L2
8.	Does the integral $\int_2^{\infty} \frac{2+\sin x}{x-1} dx$ converge?	2	4	L1
9.	Evaluate $\int_0^2 \int_0^{x^2} e^{\frac{y}{x}} \, dy \, dx$.	2	5	L2
10.	Describe the solid region whose volume is give by the following triple integral $\int_{-1}^{1} \int_{-\sqrt{1-x^2}}^{\sqrt{1-x^2}} \int_0^1 dz \, dy \, dx$.	2	5	L1

PART- B (5 x 13 = 65 Marks)

Q. No			Questions	Marks	CO	BL
11.	a.		Reduce the quadratic form $6x^2+3y^2+3z^2-4xy-2yz+4xz$ into a canonical form by using orthogonal transformation.	13	1	L3
			OR			
	b.	i.	Find eigenvalues and eigenvectors of the matrix $A=\begin{pmatrix}-2 & 2 & -3\\ 2 & 1 & -6\\ -1 & -2 & 0\end{pmatrix}$.	7	1	L3
		ii.	Using Cayley-Hamilton theorem, find the inverse of the matrix $\begin{pmatrix}2 & -1 & 2\\ -1 & 2 & -1\\ 1 & -1 & 2\end{pmatrix}$.	6	1	L4
12.	a.	i.	Verify that the function $f(x)=x^3-x$ satisfies the hypotheses of the Mean Value Theorem in the interval $[0,2]$. Then find all the numbers c that satisfy the conclusion of the theorem.	7	2	L3
		ii.	Find the absolute maximum and minimum values for $f(t)=t\sqrt{4-t^2}$ in the interval $[-1,2]$.	6	2	L4
			OR			
	b.	i.	Find the intervals on which the function $f(x)=x^4-2x^2+3$ is increasing or decreasing. Also find the local maximum and minimum values of f by using first derivative test.	7	2	L3
		ii.	Find y'' if $x^4+y^4=16$.	6	2	L4
13.	a.	i.	Obtain the Taylor's series expansion of $x^3+y^3+xy^2$ in terms of powers of $(x-1)$ and $(y-2)$ up to second degree terms.	7	3	L3
		ii.	If $x=r\sin\theta\cos\phi$, $y=r\sin\theta\sin\phi$, $z=r\cos\theta$ then find $\frac{\partial(x,y,z)}{\partial(r,\theta,\phi)}$.	6	3	L4
			OR			
	b.	i.	Examine the function $f(x,y)=x^4-y^4-2x^2+2y^2$ for local maxima and minima.	7	3	L3
		ii.	Verify Euler's theorem for the function $u=x^3-3x^2y-2y^3$.	6	3	L4
14.	a.	i.	Evaluate $\int e^{ax}\cos bx\,dx$ using integration by parts.	7	4	L3
		ii.	Evaluate $\int_0^{\frac{\pi}{2}}\cos^5 x\,dx$.	6	4	L4
			OR			
	b.	i.	Evaluate $\int \frac{x}{\sqrt{x^2+x+1}}dx$.	7	4	L4
		ii.	Evaluate $\int \frac{\sqrt{9-x^2}}{x^2}dx$.	6	4	L4

15.	a.	i.	Change the order of integration and then evaluate $\int_0^1 \int_{x^2}^{2-x} xy\,dy\,dx$.	**7**	5	L4
		ii.	Find the area that lies outside the circle $r = a\cos\theta$ and inside the circle $r = 2a\cos\theta$ using double integration.	**6**	5	L3
OR						
	b.	i.	Evaluate $\int_0^a \int_{\sqrt{ax-x^2}}^{\sqrt{a^2-x^2}} \frac{dy\,dx}{\sqrt{a^2-x^2-y^2}}$.	**7**	5	L4
		ii.	Find the area between the circle $x^2 + y^2 = a^2$ and the line $x + y = a$ lying in the first quadrant, 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.	a.	i.	The eigenvectors of a 3×3 real symmetric matrix A corresponding to the eigenvalues $2, 3, 6$ are $(1\ 0\ -1)^T$, $(1\ 1\ 1)^T$ and $(1\ -2\ 1)^T$ respectively. Find the matrix A.	**7**	1	L6
		ii.	Find the dimensions of the rectangular box without a top of maximum capacity, whose surface area is 108 sq.cm.	**8**	4	L5

ALL THE BEST