Reg. No.

B. E. / B.TECH. DEGREE EXAMINATIONS, MAY 2024
Fourth Semester
MA22456 – MATHEMATICS FOR MACHINE LEARNING
(Artificial Intelligence and Data Science)
(Regulation 2022)

TIME: 3 HOURS   **MAX. MARKS: 100**

COURSE OUTCOMES	STATEMENT	RBT LEVEL
CO 1	Apply the Counting Principles to compute the running time algorithm.	3
CO 2	Explain the fundamental concepts of Linear Algebra.	3
CO 3	Demonstrate the use of the concepts of Principal component Analysis.	3
CO 4	Solve algebraic, transcendental and linear system of equations.	3
CO 5	Appreciate the numerical techniques of interpolation in various intervals and apply the numerical techniques of differentiation and integration for engineering problems.	3

PART- A (20 x 2 = 40 Marks)
(Answer all Questions)

		CO	RBT LEVEL
1.	Use mathematical induction to prove the inequality $n < 2^n$ for all positive integers n.	1	2
2.	How many positive integers not exceeding 1000 are divisible by 7 or 11?	1	3
3.	How many different strings can be made from the letters in *ABRACADABRA*, using all the letters?	1	3
4.	What is the solution of the recurrence relation $a_n = a_{n-1} + 2a_{n-2}$ with $a_0 = 2$ and $a_1 = 7$?	1	2
5.	Determine whether or not the vectors $u = (1,1,2),\ v = (2,3,1),\ w = (4,5,5)$ in R^3 are linearly dependent.	2	2
6.	Give a spanning set of R^3.	2	2
7.	Let $V = R^3$. Check whether $W = \{(a,b,c): a \geq 0\}$ is a subspace of V.	2	2
8.	Determine whether or not each the following form a basis of R^3. $(1,1,1),\ (1,2,3),\ (2,-1,1)$	2	2

9. How to represent a data covariance matrix in Principal component analysis? **3** **2**

10. Write any two applications of Principal component analysis. **3** **2**

11. What are the key steps involved in the Principal component analysis? **3** **2**

12. Explain standardization in PCA. **3** **2**

13. When convergence does occurs in Newton-Raphson method? **4** **2**

14. Solve the linear system $x_1 - 4x_2 = -2,\ 3x_1 + x_2 = 7$ by Gauss-Jordan method. **4** **3**

15. Why Gauss-Seidel method is better than Gauss-Jordan method? **4** **2**

16. Find the inverse of $A = \begin{pmatrix} 1 & 3 \\ 2 & 7 \end{pmatrix}$ by Gauss-Jordan method. **4** **3**

17. Given $y_0 = 3,\ y_1 = 12,\ y_2 = 81,\ y_3 = 200,\ y_4 = 100$. Find $\Delta^4 y_0$ **5** **2**

18. Find the third order divided difference of $\dfrac{1}{x}$ for the arguments a, b, c, d. **5** **2**

19. Find $f'(4)$ from the table: **5** **3**

x:	0	2	3	5
y:	8	6	20	108

20. Evaluate $\displaystyle\int_0^1 \dfrac{dx}{1+x^2}$ using Trapezoidal rule with h = 0.2. **5** **3**

PART- B (5 x 10 = 50 Marks)

	Marks	CO	RBT LEVEL

21.(a) Prove that for every positive integer n, $1.2 + 2.3 + \cdots n.(n+1) = \dfrac{n(n+1)(n+2)}{3}$. **(10)** **1** **3**

(OR)

(b) Using generating function, solve the recurrence relation $a_n = 8a_{n-1} + 10^{n-1}$ and initial condition $a_0 = 1$. **(10)** 1 3

22.(a) Let R^+ be the set of all positive real numbers. **(10)** 2 3

Define addition and scalar multiplication as follows: $u + v = uv$ for all $u, v \in R^+$; $au = u^{\alpha}$ for all $u \in R^+$ and $a \in R$. Determine whether or not R^+ is a vector space over R.

(OR)

(b) Let W be the subspace of R^4 spanned by the vectors **(10)** 2 3
$u_1 = (1, -2, 5, -3)$, $u_2 = (2, 3, 1, -4)$, $u_3 = (3, 8, -3, -5)$.

Find a basis and dimension of W.

23.(a) Find the eigen values and eigen vectors for the given Covariance matrix and find the principal component sequence. **(10)** 3 3

	Red meat	White meat	Eggs
Red meat	10.7341	-5.8442	-0.605
White meat	-5.8442	15.4177	3.1362
Eggs	-0.605	3.1362	1.2653

(OR)

(b) Find the covariance matrix for the following data:

Bread	10.1	8.9	13.5	7.8	9.7	10.6	8.4
Yolk	1.4	14	9.3	6	11.4	10.8	11.6
Oats	0.5	4.3	4.1	1.6	2.8	3.7	3.7

(10) 3 3

24.(a) Find by Newton Raphson method a real positive root of $3x - \cos x - 1 = 0$ correct to 4 decimal places. **(10)** 4 3

(OR)

(b) Using Gauss-Jordan method, find the inverse of $\begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$. **(10)** 4 3

25.(a) $f(2), f(8)$ **(10) 5 3**

Using Newton's divided difference formula, find the values of $f(15)$

and from the following table.

x	4	5	7	10	11	13
$f(x)$	48	100	294	900	1210	2028

(OR)

(b) **(10) 5 3**

Find the derivative of $x^{\frac{1}{3}}$ at $x = 50$ and $x = 56$ from the following table:

x	50	51	52	53	54	55	56
$y = x^{\frac{1}{3}}$	3.6840	3.7084	3.7325	3.7563	3.7798	3.8030	3.8259

PART- C (1 x 10 = 10 Marks)
(Q.No.26 is compulsory)

	Marks	CO	RBT LEVEL

26. How many students are enrolled in a course either in calculus, discrete mathematics, data structures, or programming languages at a school if there are 507, 292, 312, and 344 students in these courses, respectively; 14 in both calculus and data structures; 213 in both calculus and programming languages; 211 in both discrete mathematics and data structures; 43 in both discrete mathematics and programming languages; and no student may take calculus and discrete mathematics, or data structures and programming languages, concurrently?   **(10) 1 3**

****