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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

B.Tech Degree S4 (Minor) Examinations April 2026 (2024 Admn)

Course Code: MNCST419

Course Name: MATHEMATICS FOR MACHINE LEARNING

Max. Marks: 60 Duration: 2 hours 30 minutes

PART A

(Answer all questions. Each question carries 3 marks)

			CO	Marks
1		Find the rank of the matrix $$A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 6 \\ 1 & 1 & 2 \end{bmatrix}$$	CO1	(3)
2		Define a vector space.	CO1	(3)
3		For a scalar function $(x,,z)$=$x^2 + 3y^2 + z^2$, find the gradient and its magnitude at the point (1,2,-1).	CO2	(3)
4		Obtain the first two terms of the Taylor series of e^xabout $x = 0$.	CO2	(3)
5		Let A and B be events such that P(A)=0.35, P(B)=0.40, and $P(A \cup B)$= 0.5, find $P(A \cap B)$.	CO3	(3)
6		What is an exponential family? Why are exponential families useful?	CO3	(3)
7		List any three advantages of Stochastic Gradient Descent in Machine Learning.	CO4	(3)
8		Why are Lagrange multipliers used in optimization problems?	CO4	(3)

PART B

(Answer any one full question from each module, each question carries 9 marks)

Module -1

			CO	Marks
9		Use the Gram-Schmidt process to obtain an orthogonal basis for the vectors (1,1,0), (1,0,1), (0,1,1)	CO1	9
10	a)	Find the eigenvalues and eigenvectors of $$A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$$	CO1	5
	b)	Determine whether the matrix is diagonalizable. If yes, diagonalize	CO1	4

it. $\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}$

Module -2

11 a) Find the critical points of $f(x)$=$x^2 - 3xy + 5x - 2y + 6y^2 + 8$ CO2 5

b) Find the linear approximation to the function $(x,)$=$2-sin\ (-x-3y)$ at the point $(0, \pi)$, and then use it to estimate $f(0.001, \pi)$. CO2 4

12 a) Find the maximum and minimum values of the function $f(x) = 4x+4y-x^2 - y^2$subject to the condition $x^2 + y^2 \leq 2$ CO2 4

b) Find the Taylor series expansion of $f(x,y) = x^2 + 2xy + y^3$ at the point (1,2). CO2 5

Module -3

13 a) A box contains 5 red and 3 blue balls. Two balls are drawn without replacement. Find the probability that both are red. CO3 4

b) A disease affects 2% of a population. A test detects the disease correctly with probability 0.95 and gives a false positive with probability 0.03. If a person tests positive, find the probability that the person actually has the disease. CO3 5

14 a) A random variable Xhas the following probability distribution: CO3 5

X	0	1	2	3
P(X=x)	0.2	0.3	0.4	0.1

Find $E(X)$and $Var(X)$.

b) Explain the importance of the Gaussian distribution in Machine Learning CO3 4

Module -4

15 Find the maximum value of $f(x,y,z)$=$xy+z$, given that $g(x,y,z)$ = $x+y+z$=3, $x \geq 0$,$y \geq 0$,$z \geq 0$ CO4 9

16 Consider the univariate function (x)=$x^3 + 6x^2 - 3x - 5$. Find its stationary points and indicate whether they are maximum, minimum, or saddle point. CO4 9

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