TE Sem VI KT – ECS (ML) C-scheme Nov 2025

11/12/25

**Duration: 3hrs** **Max Marks:80**

N.B.: (1) Question No. 1 is Compulsory.

(2) Attempt any three questions out of the remaining five.

(3) All questions carry equal marks.

(4) Assume suitable data, if required, and state it clearly.

1 Attempt any FOUR [20]

a i)Compute the $L_1$, $L_2$, and $\infty$-norms of the vectorv = [−2, 5, 3].
ii) Determine the inner (dot) product of the vectors and verify whether they are orthogonal:a = [1, 2, −1], b = [3, 0, 2].

b What are the different types regression

c Explain Hebbian Learning rule for classification

d Explain Feature Selection and Extraction concept for Dimensionality Reduction

e Explain different activation functions used in neural networks.

2 a Explain Support Vector Machines (SVM) as a constrained optimization problem, detailing the formulation of the objective function and the associated constraint conditions, and describe how Quadratic Programming is used to obtain the optimal separating hyperplane [10]

b Explain the K-means and Expectation-Maximization (EM) algorithms for clustering, and compare their working principles, assumptions, convergence behavior.. [10]

3 a What is concept of Singular Value Decomposition (SVD) and its applications. [10]

b Explain Delta Learning Rule (LMS-Widrow Hoff) with example for AND gate (Note: Bipolar AND gate). Min one epoch is required. [10]

4 a Consider a computer program for recognizing dogs in a digital photograph. There are 10 Cats and 12 Dogs in a photograph. [10]
The program identifies eight dogs. Of the eight elements identified as dogs, only five actually are dogs, the other three are cats, seven dogs were missed, and seven cats were correctly excluded. Draw Confusion Matrix, Calculate Precision, Recall & Accuracy

b Apply PCA on following given 2D data to find transformed data. Calculate Eigen values. Find largest Eigen Vector. Given (Mean of x is 8 and mean of y is 8.5) [10]

| | | | | |
|---|---|---|---|---|
| x | 4 | 8 | 13 | 7 |
| y | 11 | 4 | 5 | 14 |

5 a Explain Supervised and Unsupervised Learning with examples. What is mean by Training dataset, Testing dataset and validation dataset. [10]

b i) Design a McCulloch–Pitts neuron (specify weights and threshold) to implement each of the following logic gates: AND, OR, NOT [10]
ii) Explain why a single McCulloch–Pitts neuron cannot realize the XOR function.

6 a Derive the equations for fitting a simple linear regression model $y=\beta_0+\beta_1 x$ using the least squares method. Show all steps leading to the expressions for $\beta_0$ and $\beta_1$ [10]

b Explain the basic Feedforward Neural Network architecture. [10]

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