Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY 2025

Date: 31-05-2025 **Time:** 09:30 am – 12:30 pm

School: SOE	**Program:** B. Tech	
Course Code: ECE3020	**Course Name:** Computational Intelligence and Machine Learning	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	22	26	52		

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	Statement: "Batch techniques are involved in the process of the entire training set in one go which can be computationally costly for large data sets". A) How to overcome the drawback mentioned in above statement in case of large data sets and explain the same in detail.	**2 Marks**	**L1**	**CO1**
2.	Write the step-by-step algorithm for Linear SVM	**2 Marks**	**L2**	**CO2**
3.	Write the formula for updating membership value in Fuzzy K Means.	**2 Marks**	**L3**	**CO3**
4.	Draw the Flow chart of Particle Swarm Optimization	**2 Marks**	**L3**	**CO3**
5.	Find the Covariance Matrix of the 2-D data X: 3, 9, 12, 8 Y: 7, 5, 4, 10	**2 Marks**	**L1**	**CO1**
6.	What is a hyperplane. Give the mathematical expression for Hyperplane	**2 Marks**	**L2**	**CO2**
7.	Define Overfitting with relevant diagram	**2 Marks**	**L1**	**CO1**
8.	What is the difference between K Means and Fuzzy K Means Clustering Algorithms	**2 Marks**	**L3**	**CO3**

9.	Find the Centroid for the following data with respect to K Means Clustering.	**2 Marks**	**L3**	**CO3**

X	4	3	2	5	3	7	1
Y	6	4	1	8	5	8	2

10.	What are pBest and gBest in PSO?	**2 Marks**	**L3**	**CO3**

Part B

Answer the Questions. **Total Marks 80M**

11.	**a.**	Consider a data set X= $\{X_1, X_2, X_3 \ldots\ldots\ldots X_N\}$ and the target vector t= $\{1\ 0\ 1\ 1\}^T$. The weight vector W= $\{W_1, W_2, W_3, W_4\}$. Consider a Linear model for regression with design matric $\begin{bmatrix} 1 & 0 & 1 \\ 1 & 0 & -1 \\ 0 & 1 & 0 \\ 1 & 1 & 1 \end{bmatrix}$ then Calculate the Maximum Likelihood weight vector (W_{ML}).	**20 Marks**	**L1**	**CO 1**
		Or			
12.	**a.**	LDA can also be used in data preprocessing to reduce the number of features just as Principle component analysis which reduces the computing cost significantly. Consider two data sets as mentioned below, what will be suitable weight vector which will be used to perform classification as well as dimensionality reduction. X1= {(4,1), (2,4), (2,3),(3,6),(4,4)} X2= {(9,10),(6,8),(9,5),(8,7),(10,8)}	**20 Marks**	**L1**	**CO 1**

13.	**a.**	Given a set of labeled data points, determine the optimal separating hyperplane using the Support Vector Machine (SVM) approach. Specifically, identify the hyperplane that maximizes the margin between the two classes.	**20 Marks**	**L2**	**CO 2**

X1	X2	CLASS
2	1	+1
4	3	-1

Or					
14.	**a.**	Find the weights required to perform the following classification using Perceptron learning algorithm. The vectors (1,1,1,1) and (-1,1,-1,-1) belongs to class1 and vectors (1,1,1,-1) and (1,-1,-1,1) belongs to class -1. Assume learning rate as 1, bias as 0 and initial weights as 0.	**20 Marks**	**L2**	**CO 2**

15.	**a.**	K-means algorithm assigns data points to a cluster such that the sum of the squared distance between the data points and the cluster's centroid is at the minimum. Consider data sets X and Y as given below. Show the steps of calculation for data points until final clustering is done where no data points are changing clusters.	**20 Marks**	**L3**	**CO 3**

X	1	1	3	2	3	5

		Y	1	2	2	3	4	5					
Or													
16.	**a.**	Explain the Fuzzy K-Means clustering algorithm in a detailed and structured manner. Unlike traditional K-Means where each data point belongs strictly to one cluster, Fuzzy K-Means allows each data point to have degrees of membership across multiple clusters. Elaborate on how this 'fuzziness' is mathematically modelled and how the algorithm iteratively updates the membership values and cluster centroids. Provide a complete step-by-step breakdown of the algorithm and include key equations used in the algorithm, such as the membership function and the centroid update formula										**20 Marks**	**L3**	**CO 3**

17.	**a.**	Ant colony optimization (ACO) is an optimization algorithm which employs the probabilistic technique and is used for solving computational problems and finding the optimal path with the help of graphs. Consider the problem of finding the optimum order in which the numbers from 1 to 9 are arranged so that the cost of order is maximum. Assume that six ants have the cost functions (C1, C2, C3, C4, C5, and C6). Consider the following are the orders selected by the six ants along with the corresponding Cost as given below.										**20 Marks**	**L3**	**CO 3**

ANT Number	ORDER									COST
ANT1	3	2	4	1	7	5	8	6	9	C1
ANT2	5	8	9	2	7	3	6	4	1	C2
ANT3	5	6	8	2	3	9	7	1	4	C3
ANT4	8	4	9	6	3	1	2	7	5	C4
ANT5	5	6	7	3	4	1	9	2	8	C5
ANT6	4	6	7	8	1	2	5	9	3	C6

Or													
18.	**a.**	Consider a scenario that, five particles (Say A, B, C, D and E) are moving around the solution space (Say P). Each particle moves around the solution space randomly but at the same time attracted by other poles, its past best position (solution) and the best position (solution) of the whole swarm (collection of particles). These poles modify the velocity vector of the particles at each iteration. How these swarms modify their velocity vectors in the form of their position. Form an algorithm with suitable equations and draw the flow chart.										**20 Marks**	**L3**	**CO 3**