Roll No.											

GAIN MORE KNOWLEDGE
REACH GREATER HEIGHTS

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – December 2025

Date: 08-12- 2025 **Time:** 01:00pm – 04:00pm

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

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**24**	**22**	**16**	**28**	**10**

Instructions:

(i) Read all questions carefully and answer accordingly.

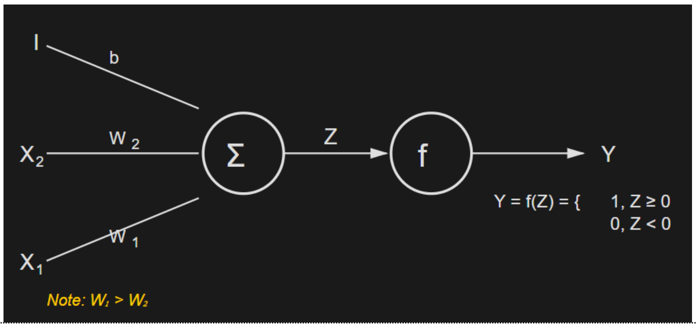
(ii) Do not write anything on the question paper other than roll number.

Part A

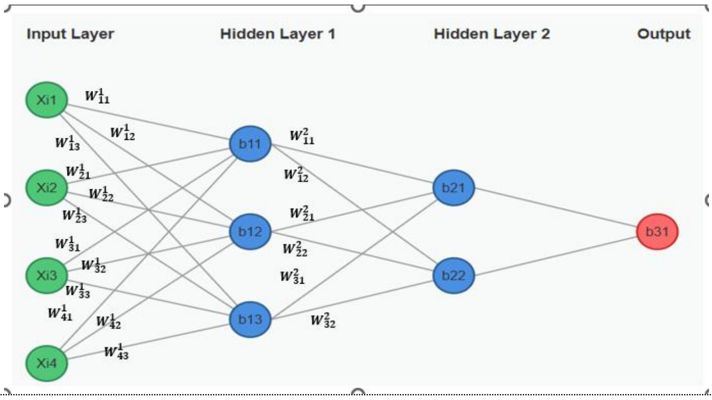
Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	In hierarchical clustering, relationships between data points are often represented visually. What is a Dendrogram?	**2 Marks**	**L2**	**CO3**
2.	The given example shown below comes under which type of machine learning? Three customers have made the following purchases: Customer 1: Bread, Milk, Fruits, Wheat Customer 2: Bread, Milk, Rice, Butter Customer 3: Bread, ? List four real-world applications where this learning approach is used.	**2 Marks**	**L2**	**CO3**
3.	In large datasets, dimensionality reduction is essential to improve model performance and visualization. What is the main purpose of using Principal Component Analysis (PCA) in Machine Learning?	**2 Marks**	**L2**	**CO3**
4.	In classification problems, decision boundaries separate data points of different classes. Explain how the decision boundary is represented for data with 2 features, 3 features, and more than 3 features.	**2 Marks**	**L2**	**CO4**

5.	In the given perceptron diagram, $W_1 > W_2$. Interpret this observation and explain what it signifies in terms of feature importance and decision making.	**2 Marks**	**L2**	**CO4**



6.	For the given Artificial Neural Network (ANN) diagram, calculate the total number of trainable parameters (weights and biases) and justify your computation.	**2 Marks**	**L2**	**CO4**



7.	Machine learning tasks often involve predicting either discrete labels or continuous values. Differentiate between classification and regression problems, and provide one real-world example for each.	**2 Marks**	**L2**	**CO1**
8.	A confusion matrix summarizes the performance of a classification model. Describe its structure and purpose. Explain how it helps in evaluating the accuracy and reliability of a classifier.	**2 Marks**	**L2**	**CO1**
9.	Machine learning models can be trained with or without labeled data. Explain the concepts of supervised and unsupervised learning, illustrating your answer with one suitable example for each.	**2 Marks**	**L2**	**CO2**
10.	What is an activation function in an Artificial Neural Network (ANN)? Mention two commonly used activation functions.	**2 Marks**	**L2**	**CO4**

Part B

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

11.	**a.**	A machine can be considered to learn if it is able to gather experience by doing a certain task and improve its performance in doing the similar task in future. What are the two types of unsupervised machine learning? Write difference between them.	**10 Marks**	**L2**	**CO2**

	b.	Clustering algorithms group data based on similarity. Explain the K-Means algorithm for clustering and discuss its major drawbacks.	**10 Marks**	**L2**	**CO3**
Or					
12.	**a.**	Hierarchical clustering builds nested groupings of data points. Explain the two main types—Agglomerative and Divisive clustering—and highlight their differences.	**10 Marks**	**L2**	**CO3**
	b.	Tree-based models are widely used for classification and regression. Explain the Decision Tree and Random Forest algorithms, and write key differences between them.	**10 Marks**	**L2**	**CO2**

13.	**a.**	A streaming platform has collected viewing data from 10 users who watched various Christopher Nolan movies. Using the data below, calculate the support and confidence for the association rule {Inception} → {Interstellar}.	**10 Marks**	**L3**	**CO2**

User ID	Movies Watched
U1	Inception, Interstellar, The Prestige
U2	Inception, Interstellar
U3	Interstellar, The Prestige, Dunkirk
U4	Inception, Interstellar, The Prestige
U5	Inception, The Prestige
U6	Interstellar, The Prestige
U7	Inception, Interstellar, Dunkirk
U8	Inception, Interstellar, The Prestige
U9	Inception, The Prestige
U10	Interstellar, Dunkirk

	b.	A spam email detection system was tested on 200 emails with results summarized in the confusion matrix below. Using the given data, calculate Accuracy, Precision, Recall (Sensitivity), Specificity, and F1-Score. Interpret the importance of each metric in evaluating the model's performance.	**10 Marks**	**L3**	**CO2**

	ACTUAL Spam	**ACTUAL Not Spam**	**Total**
PREDICTED Spam	75	15	90
PREDICTED Not Spam	20	90	110
Total	**95**	**105**	**200**

Or

14.	**a.**	Principal Component Analysis (PCA) helps reduce data dimensionality while preserving variance. Explain the working of PCA with a suitable example. Also, differentiate between feature selection and feature extraction in PCA.	**10 Marks**	**L3**	**CO3**
	b.	A perceptron acts as a basic computational unit in neural networks. Define a perceptron and explain its different parameters.	**10 Marks**	**L2**	**CO3**

15.	**a.**	Artificial neural networks are inspired by biological neurons. Explain the similarities and differences between a perceptron and a biological neuron.	**10 Marks**	**L2**	**CO4**
	b.	The architecture of an Artificial Neural Network can be adjusted to suit specific problems. Explain how the architecture of an ANN can be changed and discuss the factors influencing these changes.	**10 Marks**	**L2**	**CO5**
		Or			
16.	**a.**	Neural networks can process data either in a static or sequential manner. Explain how a Feedforward Neural Network (FNN) differs from a Recurrent Neural Network (RNN).	**10 Marks**	**L2**	**CO4**
	b.	The XOR function is a classic example used to demonstrate linear separability. Explain why the XOR function is not linearly separable and illustrate your explanation using a 2D plot.	**10 Marks**	**L3**	**CO5**

17.	**a.**	Neural networks learn by minimizing error through iterative adjustment of weights. Explain the concept and working of the Backpropagation algorithm.	**10 Marks**	**L2**	**CO4**
	b.	Convolutional Neural Networks (CNNs) are widely used in computer vision tasks. Explain the architecture and applications of CNNs. How can you identify that an ANN is a CNN by observing its structure?	**10 Marks**	**L2**	**CO4**
		Or			
18.	**a.**	Machine learning models may perform well on training data but poorly on unseen data. Analyze the concepts of overfitting and underfitting, discuss their causes and effects, and suggest strategies to mitigate each issue.	**10 Marks**	**L4**	**CO1**
	b.	Regression models can capture linear or nonlinear relationships in data. Compare linear regression and polynomial regression techniques in terms of assumptions, model complexity, and suitability for different datasets.	**10 Marks**	**L3**	**CO1**