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Bengaluru

Mid Term Examinations - October 2026

Date: 05/10/2026 **Time:** 02:00 PM - 03:30 PM

Course Code: CAI2512 **Course Name:** Neural Networks and Fuzzy Logic

Semester: Fifth Semester **Max. Marks:** 50 **Weightage:** 50%

CO - Levels	CO1	CO2
Marks	92	88

PART A: Answer Following Questions. 10 M

Q.N.	Questions	M	CO	BT
1	State the basic mathematical operation performed by an artificial neuron before applying the activation function.	2	CO1	BT1
2	Why can a single-layer perceptron solve only linearly separable classification problems?	2	CO1	BT2
3	State two important differences between supervised learning and unsupervised learning.	2	CO1	BT1
4	Define the local gradient used in the backpropagation algorithm.	2	CO2	BT1
5	Distinguish between a function signal and an error signal in a multilayer perceptron.	2	CO2	BT2

PART B : Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
6	For the neuron shown in Figure 1, X = [1, 0, 1], W = [0.4, 0.2, 0.3], and bias b = -0.4. The neuron uses a binary step activation with threshold 0. Calculate (a) the net input, (b) the output, (c) the predicted class, and (d) the effect of changing the bias to b = -0.1 on the final decision.	10	CO1	BT3
7	A single neuron is trained using Hebb's learning rule $\Delta w_i = x_i t$. For X = [1, -1, 1], target t = -1, and initial weights W = [0.2, -0.3, 0.4], calculate $\Delta w1$, $\Delta w2$, $\Delta w3$ and the updated weights. Explain the meaning of the positive and negative weight changes.	10	CO1	BT3

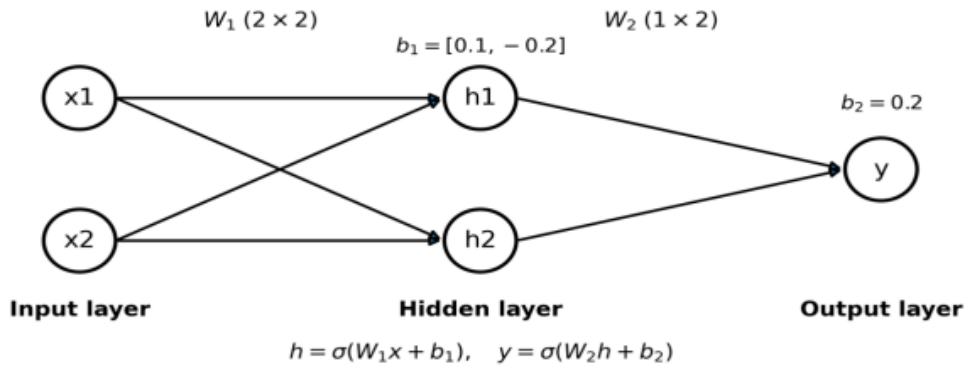
PART C: Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
8	A single-layer perceptron receives X = [1, -1]. The target is t = +1, the current output is y_out = -1, learning rate $\eta = 0.5$, initial weights are w1 = 0.2 and w2 = 0.4, and the bias input is x0 = 1 with w0 = 0.1. Using $\Delta w_i = \eta(t - y_{out})x_i$, calculate $\Delta w0$, $\Delta w1$, $\Delta w2$ and all updated weights.	10	CO2	BT3
9	A linear neuron uses the LMS rule $\Delta w_i = \eta(t - y_{in})x_i$. Given $\eta = 0.2$, t = 0.8, y_in = 0.5, X = [1, -1], and initial weights W = [0.3, -0.4], calculate the error term, $\Delta w1$, $\Delta w2$, the updated weights, and the squared error for the training pattern.	10	CO2	BT3

PART D: Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
10	For the bipolar NOR function, use inputs in {-1, +1} and output in {-1, +1}. Using the neuron architecture in Figure 2, (a) write the complete bipolar NOR truth table, (b) determine suitable values of w1, w2, and bias b, and (c) verify the net input and final output for all four input combinations. Show all calculations.	10	CO1	BT3
11	(a) Write the XOR truth table. (b) Plot or interpret the four points and explain why one linear decision boundary cannot separate the classes. (c) Explain why two boundary lines are sufficient. (d) Draw a suitable two-layer MLP to solve XOR and clearly indicate the role of the hidden layer.	10	CO1	BT3

PART E: Answer Any 1 Following Questions. 10 M

Q.N.	Questions	M	CO	BT
12	**Figure 4: Two-Layer MLP for the Numerical Question**  For the MLP shown in Figure 4, let X = [1, 0], target t = 1, learning rate η = 0.5, hidden-layer weights W1 = [[0.2, -0.3], [0.4, 0.1]], hidden biases b1 = [0.1, -0.2], output weights W2 = [0.5, -0.4], and output bias b2 = 0.2. Use the sigmoid function φ(z) = 1/(1 + e^(-z)). Calculate (a) the hidden-layer net inputs and activations, (b) the output net input and output, (c) the output error e = t - y, (d) the output local gradient δ = e φ'(v), (e) ΔW2 for both output weights, and (f) the updated output weights. Show all intermediate steps.	10	CO2	BT3
13	Explain why the error of a hidden neuron cannot be obtained directly from a target value. Derive the hidden-neuron local-gradient expression **For** ϕj′(vj)=0.5, δ1=0.2, δ2=0.1, w1j=0.6, and w2j=−0.2, **calculate δj.** **Finally, write the weight-correction expression for a weight wji connecting an earlier neuron ii to hidden neuron jj.**	10	CO2	BT4