

**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI  
(END SEMESTER EXAMINATION)**

**CLASS: MTECH  
BRANCH: COMPUTER SCIENCE AND ENGINEERING**

**SEMESTER : II  
SESSION : SP/2025**

**SUBJECT: CS535 MACHINE LEARNING**

**TIME: 3 Hours**

**FULL MARKS: 50**

**INSTRUCTIONS:**

1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.

- Q.1(a) Build a linear regression model to find the regression parameters for the following dataset. [5] CO 1 BL 1

X1	X2	Y
0	1	6
0	0	4
1	0	5
1	1	7

- Q.1(b) Explain about overfitting and underfitting of a machine learning model. What is a “good fit model”. Explain with graphical representation. [5] CO 1 BL 5

- Q.2(a) Construct a Decision Tree using ID3 algorithm with the data given: [5] CO 2 BL 1

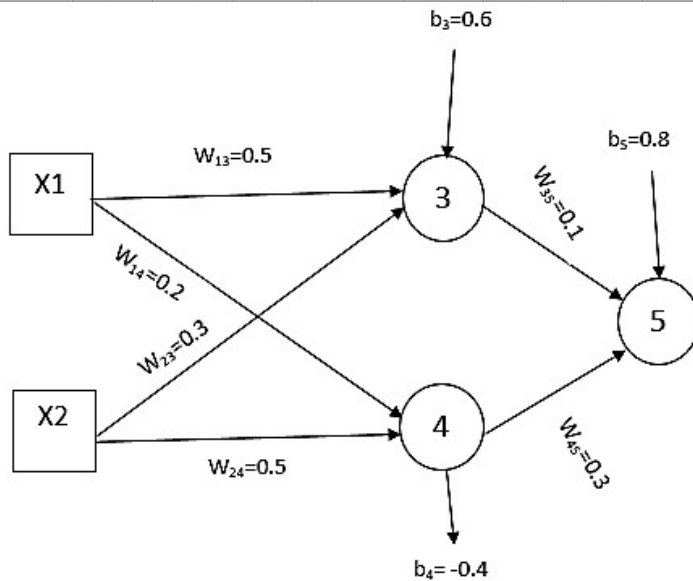
City	Job	Gender	Class
Bangalore	Employed	Male	Yes
Chennai	Student	Male	Yes
Chennai	Employed	Male	No
Chennai	UnEmployed	Male	No
Bangalore	Employed	Female	Yes
Bangalore	Student	Female	No
Chennai	Employed	Female	Yes

- Q.2(b) Considering Support Vector Machine concept, with the following: Positively labelled data points (2,2)(2,-2)(-2,-2)(-2,2) and Negatively labelled data points (1,1)(1,-1)(-1,-1)(-1,1). Given the Kernel function, find the separating hyperplane [5] CO 2 BL 4

$$\phi \begin{pmatrix} x_1 \\ x_2 \end{pmatrix} = \begin{cases} \begin{pmatrix} 4 - x_2 + |x_1 - x_2| \\ 4 - x_1 + |x_1 - x_2| \end{pmatrix}, & \text{if } \sqrt{x_1^2 + x_2^2} > 2 \\ \begin{pmatrix} x_1 \\ x_2 \end{pmatrix}, & \text{Otherwise.} \end{cases}$$

- Q.3(a) Consider a multilayer feed-forward neural network given below. Let the learning rate be 0.5. Assume initial values of weights and biases as given in the table below. Train the network for the training tuples (1, 1, 0) and (0, 1, 1), where last number is target output for 2 iterations. Show weight and bias updates by using back-propagation algorithm. Assume that sigmoid activation function is used in the network. [5] CO 3 BL 3

W13	W14	W23	W24	W35	W45	b3	b4	b5
0.5	0.2	-0.3	0.5	0.1	0.3	0.6	-0.4	0.8



- Q.3(b) Draw and train a single-layer perceptron to learn the 2-input logical AND function. Assume learning rate =0.5. Initialize weights  $w_1=1.2$ ,  $w_2=0.6$ , and bias with 0. Calculate for 2 passes/epochs. [5] 3 3
- Q.4(a) Apply K(=2)-means algorithm over the data points: P1(185, 72), P2(170, 56), P3(168, 60), P4(179,68), P5(182,72), P6(188,77) up to two iterations and show the clusters. Initially choose P1, P2 as centroids. Give appropriate diagrams. [5] 4 4
- Q.4(b) Explain the concept of EM Algorithm for soft clustering. Give example to elaborate. [5] 5 5
- Q.5(a) Define ensemble learning. How is Bagging Different from the Random Forest Algorithm? What ensemble techniques can be used to aggregate multiple models? Elaborate. [5] 2 5
- Q.5(b) Find the final classification for the data provided using stacking. The Metamodel (SVM) learns the pattern and provides the classification. [5] 5 2

Sample	LR	DT	RF	True Label
1	0	1	1	1
2	1	0	1	1
3	1	1	1	1
4	0	0	0	0
5	1	1	0	0

Weights are given as: WLR = 0.4, WRF = 0.3, WDT = 0.3.

:::::01/05/2025:::::E