

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

CLASS: BTECH  
BRANCH: AI

SEMESTER : V  
SESSION : MO/2025

**SUBJECT: AI363 INTRODUCTION TO 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.
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- |  |                 | CO             | BL |    |   |    |   |    |   |    |  |  |  |
|--|-----------------|----------------|----|----|---|----|---|----|---|----|--|--|--|
| Q.1(a) What do you understand by Machine Learning? Explain the various types of Machine Learning.  | [5]             | CO1            | 1  |    |   |    |   |    |   |    |  |  |  |
| Q.1(b) Consider the dataset:<br>$X = \begin{bmatrix} 2.5, & 2.4, \\ 0.5, & 0.7, \\ 2.2, & 2.9, \\ 1.9, & 2.2, \\ 3.1, & 3.0 \end{bmatrix}$<br>(i) Calculate the covariance matrix.<br>(ii) Compute eigenvalues and eigenvectors.<br>(iii) Reduce the data to 1 principal component.  | [5]             | CO3            | 3  |    |   |    |   |    |   |    |  |  |  |
| Q.2(a) Consider the following dataset representing the relationship between study hours (X) and test scores (Y):   | [5]             | CO3            | 5  |    |   |    |   |    |   |    |  |  |  |
| <table border="1" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th>X (Study Hours)</th> <th>Y (Test Score)</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">2</td> <td style="text-align: center;">81</td> </tr> <tr> <td style="text-align: center;">4</td> <td style="text-align: center;">93</td> </tr> <tr> <td style="text-align: center;">6</td> <td style="text-align: center;">91</td> </tr> <tr> <td style="text-align: center;">8</td> <td style="text-align: center;">97</td> </tr> </tbody> </table> | X (Study Hours) | Y (Test Score) | 2  | 81 | 4 | 93 | 6 | 91 | 8 | 97 |  |  |  |
| X (Study Hours)  | Y (Test Score)  |                |    |    |   |    |   |    |   |    |  |  |  |
| 2  | 81              |                |    |    |   |    |   |    |   |    |  |  |  |
| 4  | 93              |                |    |    |   |    |   |    |   |    |  |  |  |
| 6  | 91              |                |    |    |   |    |   |    |   |    |  |  |  |
| 8  | 97              |                |    |    |   |    |   |    |   |    |  |  |  |
| (i) Compute the regression line of the form $Y = \theta_0 + \theta_1 X$ .<br>(ii) Predict the test score when a student studies for 5 hours.<br>(iii) Calculate the Mean Squared Error (MSE) for the given data using your regression model.   |                 |                |    |    |   |    |   |    |   |    |  |  |  |
| Q.2(b) Describe the role of regularization techniques in addressing overfitting. How do regularization methods, such as L1 and L2 regularization, help in achieving a better balance between bias and variance?  | [5]             | CO2            | 4  |    |   |    |   |    |   |    |  |  |  |
| Q.3(a) Define confusion matrix and calculate Accuracy, Precision, Recall and F1 Score for the following values: TP=30, TN=50, FP=10, FN=10.  | [5]             | CO5            | 5  |    |   |    |   |    |   |    |  |  |  |
| Q.3(b) Compare Decision Tree and Support Vector Machine in terms of bias, variance, and interpretability.  | [5]             | CO4            | 3  |    |   |    |   |    |   |    |  |  |  |
| Q.4(a) What are <i>Artificial Neural Networks (ANNs)</i> ? Discuss the basic model of an ANN.  | [5]             | CO4            | 2  |    |   |    |   |    |   |    |  |  |  |
| Q.4(b) Describe the McCulloch-Pitts Neuron model and its limitations.  | [5]             | CO4            | 2  |    |   |    |   |    |   |    |  |  |  |
| Q.5(a) Define clustering .For the given data points, perform one iteration of K-Means clustering with k=2: Data = [(1,1), (2,1), (4,3), (5,4)] and initial centroids = (1,1), (5,4).   | [5]             | CO2            | 3  |    |   |    |   |    |   |    |  |  |  |
| Q.5(b) Explain Agglomerative and Divisive Hierarchical Clustering with suitable <i>dendrogram diagrams</i> .   | [5]             | CO4            | 2  |    |   |    |   |    |   |    |  |  |  |