Mahindra University Hyderabad
École Centrale School of Engineering,
Minor-1 Examination

Program: B.Tech **Branch: Computation & Mathematics** **Year: III**
Semester: II
Subject: Mathematical Foundations for Machine Learning (MA3219)

Date: 24/02/2025 **Start Time: 10.00 AM**
Time Duration: 1.5 Hours **Max. Marks: 20**

Instructions:

1. All questions are compulsory.

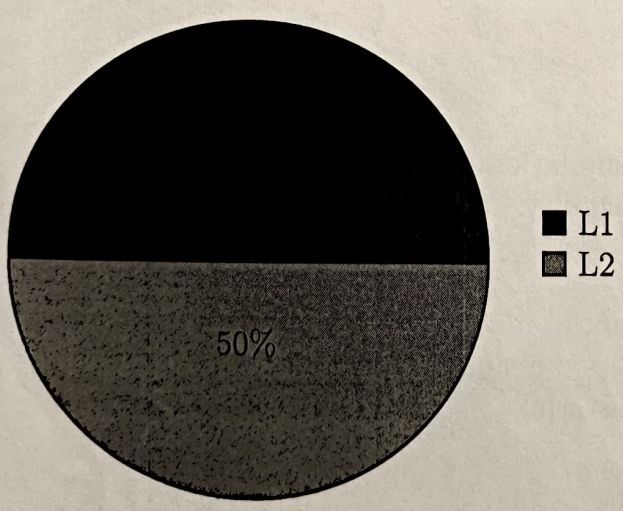
Course Outcomes:

1. Understand the Fundamentals: Gain a solid foundation in machine learning concepts, including types, mathematical setups, and feasibility.

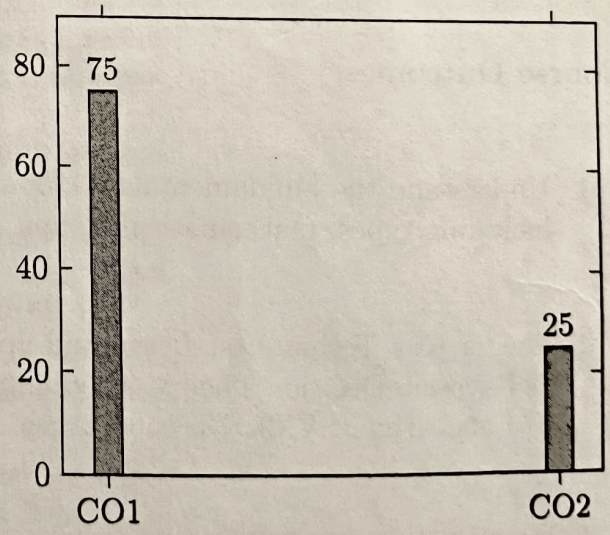
2. Master Key Techniques: Learn and apply essential machine learning techniques such as Bayesian Decision Theory, Maximum Likelihood estimation, Naïve-Bayes Classifier, EM algorithm, SVMs, Decision Trees, and Clustering.

3. Develop Analytical Skills: Analyze and evaluate the performance of various machine learning models and techniques.

Q.No	Question	Marks	CO	BL	PO	PI
1	State and prove Chebyshev-Cantelli inequality.	5	CO1	L1	1	1.2.1
2	For the perceptron in 3 dimensions, let $$m_{\mathcal{H}}(N) = 2\sum_{i=0}^{3}\binom{N-1}{i}.$$ Use this formula to verify that $d_{vc} = 4$ by evaluating $m_{\mathcal{H}}(4)$ and $m_{\mathcal{H}}(5)$.	5	CO1	L2	2	1.1.3
3	Suppose that we have a learning model with $d_{vc} = 3$ and would like the generalization error to be at most 0.1 with confidence 90% (so $\epsilon = 0.1$ and $\delta = 0.1$). How big a data set do we need? Hint: Use VC generalization bound	5	CO1	L2	1	1.2.1
4	Consider a classification problem with two classes, C_1 and C_2. The prior probabilities of these classes are $P(C_1) = 0.6$ and $P(C_2) = 0.4$. The likelihoods of observing a feature vector $\mathbf{X} = (x_1, x_2)$ given the classes are $P(\mathbf{X}\|C_1) = 0.7$ and $P(\mathbf{X}\|C_2) = 0.3$. Given the feature vector $\mathbf{X} = (2, 3)$, use Bayes' theorem to determine the class to which this vector most likely belongs.	5	CO2	L3	2	2.1.2



(a) Bloom's Level wise Marks Distribution



(b) Course Outcome wise Marks Distribution