Indian Institute of Technology Roorkee
Mid-Term Examination (MTE)
AI Techniques (IEC-03)

Time: 90 Minutes **Autumn Semester 2023-24** **MM: 100 Marks**

1) What is Machine Learning? Describe the difference between Machine Learning and traditional programming methods? Discuss the relation between AI and Machine Learning? What are the three types of Machine Learning? Mention their probabilistic interpretation, wherever relevant. Describe each type along with an example of a problem solved using each type? Also, mention if any sub-types exist under each of them? Also, mention if there are any specialized flavors of ML other than the ones above. (15 Marks)

2) Explain feature extraction and feature selection with examples? (6 Marks)

3) Explain the problem of perception and limitations or issues with current human perception approaches? (4 Marks)

4) Derive the least squares estimate of linear regression? Explain and derive the gradient descent update law for linear regression. (10 Marks)

5) Draw a decision tree, explain the different types of nodes, depth and define Gini impurity? You may pick up any example of a decision tree and explain. What is the difference between pruning and splitting? Which algorithm is used for building a tree? What are the stopping criteria for a decision tree? Also, describe tips for usage of decision trees? (15 Marks)

6) Explain the k-NN approach with parameter tuning and limitations? (5 Marks)

7) Derive and explain SVM hard margin basic condition? Further formulate the primal problem and dual problem? In which practical application, SVM was primarily used or developed for early use? Explain the role of slack variables in soft margin SVM? (10 Marks)

8) What are different kinds of ensemble learning approaches, their types/sub-types and appropriate types of ML models for each of the ensembles, wherever relevant? Derive proof for bias and variance tradeoff? With the eye-diagram, indicate bias, variance tradeoff and nature of fit of ML models? (15 Marks)

9) Motivate the reasons and purpose of PCA, further describe the algorithm of PCA in complete for all the methods? Also, indicate clearly how to select the components. (10 Marks)

10) Describe all the metrics and/or cost functions in use for regression and classification problems and indicate their limitations and advantages/scope wherever relevant? Describe cross validation method? (10 Marks)