# INSTITUTE OF AERONAUTICAL ENGINEERING
(Autonomous)
Dundigal, Hyderabad - 500 043

## COMPUTER SCIENCE AND ENGINEERING (AI & ML)
## QUESTION BANK

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| Department | **COMPUTER SCIENCE AND ENGINEERING (AI & ML)** | | | | |
| Course Title | **FOUNDATIONS OF MACHINE LEARNING** | | | | |
| Course Code | ACAC03 | | | | |
| Program | B.Tech | | | | |
| Semester | IV | | | | |
| Course Type | Core | | | | |
| Regulation | UG-20 | | | | |
| Course Structure | Theory | | | Practical | |
| | Lecture | Tutorials | Credits | Laboratory | Credits |
| | 3 | 1 | 4 | - | - |
| Course Coordinator | Dr. Shaik Jakeer Hussain, Associate Professor | | | | |

## COURSE OBJECTIVES:
**The students will try to learn:**

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| I | The fundamental concepts, issues and challenges of Machine Learning associated to data for model selection . |
| II | The Supervised learning methods such as decision trees, Naïve Bayes classifier, k-nearest neighbor learning for building data models and basics of Unsupervised learning methods. |
| III | The knowledge on Machine Learning algorithms correlated with paradigms of Supervised and Un-Supervised learning |
| IV | The knowledge used for making predictions or decisions without human intervention on real-world problems |

## COURSE OUTCOMES:
**After successful completion of the course, students should be able to:**

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| CO 1 | **Outline** the need for Machine Learning, various learning tasks, and statistical learning framework | Understand |
| CO 2 | **Make use of** different supervised learning algorithms to solve data classification problems. | Apply |
| CO 3 | **Apply the** Ensemble and Probabilistic learning techniques to combine the predictions from two or more models. | Apply |

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| CO 4 | **Acquire the knowledge** about different unsupervised learning algorithms for clustering of the data. | Apply |
| CO 5 | **Discuss** the advanced supervised learning techniques to solve the classification problems. | Apply |
| CO 6 | **Apply the algorithms** to a real problem, optimize the models learned, and assess their performance efficiency. | Apply |

## QUESTION BANK:

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| **MODULE I** | | | | |
| **INTRODUCTION TO MACHINE LEARNING** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Imagine you're working on a machine learning project, and the dataset contains a significant amount of noisy data. How would you identify and handle noisy data to ensure the robustness and reliability of the model? Discuss various techniques for noise detection, such as outlier detection, and strategies for data cleaning and preprocessing. | Remember | — | CO 1 |
| 2 | Consider a scenario where you have access to limited labelled data for training a machine learning model, but acquiring additional labelled data is costly or time-consuming. How would you improve model performance? | Remember | — | CO 1 |

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| 3 | Suppose you're building a machine learning model for a critical application, such as healthcare or finance, where model interpretability and explainability are essential. How would you ensure that the model's predictions are transparent and understandable to end-users or stakeholders? | Remember | — | CO 1 |
| 4 | If you were to design an experiment to determine the best predictive model for a dataset with multiple features and a continuous target variable, how would you evaluate and contrast the predictive capabilities of distinct algorithms, such as linear regression, decision trees, and support vector machines, in order to ascertain their respective effectiveness in modeling a dataset with multiple features and a continuous target variable? | Remember | — | CO 1 |
| 5 | Once you've trained a predictive model on historical data, what steps would you take to implement the model in a production environment and continuously track its performance as time progresses? | Remember | — | CO 1 |

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| 6 | Compare and contrast the advantages and disadvantages of scanning and emailing images versus utilizing an optical character reader (OCR) to send text files. Under what circumstances would one approach be more advantageous than the other? | Understand | — | CO 1 |
| 7 | Let us say we are building an OCR and for each character, we store the bitmap of that character as a template that we match with the read character pixel by pixel. Explain when such a system would fail. Why are barcode readers still used? | Understand | — | CO 1 |
| 8 | Assume we are given the task of building a system to distinguish junk email. What is in a junk email that lets us know that it is junk? How can the computer detect junk through a syntactic analysis? What would we like the computer to do if it detects a junk email—delete it automatically, move it to a different file, or just highlight it on the screen? | Remember | — | CO 1 |

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| 9 | If a face image is a 100 × 100 image, written in row-major, this is a 10,000-dimensional vector. If we shift the image one pixel to the right, this will be a very different vector in the 10,000-dimensional space. How can we build face recognizers robust to such distortions? | Remember | — | CO 1 |
| 10 | In basket analysis, we want to find the dependence between two items X and Y. Given a database of customer transactions, how can we find these dependencies? How would we generalize this to more than two items? | Remember | — | CO 1 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | Explain Learning paradigms in detail | Understand | The learner will try to **recall** diffferent machine learning paradigms used and then **identify** the relevant one | CO 1 |
| 2 | What are the benefits of Machine Learning? List out the applications of Machine Learning? | Remember | — | CO 1 |
| 3 | Explain in detail about Empirical Risk Minimization and Discuss how it can be handled using Finite Hypothesis classes | Understand | The learner will try to **recall** the concept of Empirical Risk Minimization and then **illustrate** the implementation using Finite Hypothesis Class | CO 1 |
| 4 | Explain each Machine Learning stages that are commonly used with an example. | Understand | The learner will try to **recall** diffferent machine learning stages used and then **identify** the relevant one | CO 1 |

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| 5 | Explain in detail about Empirical Risk Minimization and Discuss how it can be handled using Inductive Bias | Understand | The learner will try to **recall** the concept of Empirical Risk Minimization and then **illustrate** the implementation using Inductive Bias | CO 2 |
| 6 | What are the examples of Machine Learning in detail? | Remember | — | CO 2 |
| 7 | Explain Standard Learning Tasks | Understand | The learner will try to **recall** the concept of Learning and then **illustrate** the different learning stages | CO 1 |
| 8 | Explain i.i.d assumption | Understand | The learner will try to **recall** the concept of i.i.d Algorithm and then **illustrate** the implementation | CO 1 |
| 9 | What are Different Learning Scenarios | Remember | — | CO 1 |
| 10 | Explain Different Learning stages | Understand | The learner will try to **recall** different learning stages and then **identify** which can be used in real life domain | CO 1 |
| 11 | Explain the need for Machine Learning | Understand | The learner will try to **recall** the concept of machine learning and then **Demonstrate** their significance in solving real world problems | CO 1 |
| 12 | Explain General Learning Scenarios in detail | Understand | The learner will try to **recall** the concept of learning and then **identify** best learning scenario | CO 1 |
| 13 | Explain the different types of Learning in detail. | Understand | The learner will try to **recall** different learning scenarios and then **Demonstrate** their implementation | CO 1 |

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| 14 | Explain the Statistical Learning Frame work in detail | Understand | The learner will try to **recall** the concept of statistical Learning and then **Demonstrate** its frame work | CO 1 |
| 15 | Explain in detail about PAC Learning | Understand | The learner will try to **recall** the concept of PAC Learning and then **Demonstate** its application | CO 1 |
| 16 | What are Different Types of Machine Learning algorithms? | Remember | — | CO 1 |
| 17 | Compare Inductive learning and Deductive learning? | Understand | The learner will try to **recall** the concept of Inductive and Deductive Learning and then **Demonstate** its differences | CO 1 |
| 18 | Explain in detail Finite Hypothesis classes | Understand | The learner will try to **recall** the concept of Finite Hypothesis Classes and then **Demonstate** its implementation | CO 1 |
| 19 | Explain with an example how overfitting occurs and Define Overfitting in Machine learning? | Understand | The learner will try to **recall** the concept of Overfitting and then **Demonstrate** its application in Machine Learning | CO 1 |
| 20 | Why overfitting occurs? | Remember | — | CO 1 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | What is meant by the term Machine Learning? | Remember | — | CO 1 |
| 2 | What is Machine Learning and how it works in real life Domain? | Remember | — | CO 1 |
| 3 | How Does Machine Learning Work? | Remember | — | CO 1 |
| 4 | What are the types of Machine Learning? | Remember | — | CO 1 |
| 5 | What are the methods of Machine Learning? | Remember | — | CO 1 |

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| 6 | What are the advantages and disadvantages of Machine Learning? | Remember | — | CO 1 |
| 7 | What is learning task in Machine Learning? | Remember | — | CO 1 |
| 8 | What are the applications of Machine Learning? | Remember | — | CO 1 |
| 9 | What is Statistical Model in Machine Learning? | Remember | — | CO 1 |
| 10 | What is PAC Learning explain with example? | Remember | — | CO 1 |
| 11 | What are the five popular algorithms of Machine Learning? | Remember | — | CO 1 |
| 12 | Who is the founder of Machine learning? | Remember | — | CO 1 |
| 13 | What are the kinds of problem which can be solved using Machine Learning? | Remember | — | CO 1 |
| 14 | What is the main use of Machine Learning? | Remember | — | CO 1 |
| 15 | What is a Neural Network? | Remember | — | CO 1 |
| 16 | What are the benefits of Machine Learning? | Remember | — | CO 1 |
| 17 | What is Empirical Risk Minimization? | Remember | — | CO 1 |
| 18 | What is the need for Inductive Bias ? Explain Confidence parameter | Remember | — | CO 1 |
| 19 | Explain the Risk minimization using Finite Hypothesis Class in short | Understand | The learner will try to **recall** then concept of Risk Minimization and then **solve** it using Finite Hypotheisi Class | CO 1 |
| 20 | How do you Measure Success | Remember | — | CO 1 |
| **MODULE II** | | | | |
| **SUPERVISED LEARNING ALGORITHMS** | | | | |
| **PART-A PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |

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| 1 | Given a dataset containing various patient attributes and their corresponding medical conditions, how would you design a classification model to predict the likelihood of a certain disease based on these attributes? What factors would you consider important in making accurate predictions, and how would you evaluate the performance of your model? | Remember | — | CO 2 |
| 2 | Suppose you are developing a spam filter for an email service provider. How would you build a classification model to distinguish between spam and legitimate emails? What features or characteristics of emails might be indicative of spam, and how would you evaluate the performance of your spam detection system? | Remember | — | CO 2 |
| 3 | You work for an e-commerce company and want to segment customers into different groups based on their purchasing behaviour. How could you use a decision tree approach to identify distinct customer segments? What criteria would you use for splitting nodes in the tree, and how would you interpret the segments generated by the tree? | Remember | — | CO 2 |

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| 4 | Suppose you are an HR manager tasked with analysing employee attrition within your organization. Explain how CART (Classification and Regression Trees) could be applied to identify the factors contributing to employee turnover within an organization, elucidating the process of constructing a decision tree to discern the most influential predictors and their thresholds, thus facilitating a deeper understanding of the underlying drivers behind employee attrition. | Understand | — | CO 2 |
| 5 | If you're working for a real estate agency and tasked with predicting house prices based on various features such as square footage, number of bedrooms, location, etc. How would you approach this regression problem? What regression techniques would you consider, and how would you evaluate the performance of your predictive model? | Remember | — | CO 2 |
| 6 | You work for a financial institution and need to detect fraudulent transactions. How could logistic regression be used to classify transactions as either fraudulent or legitimate? | Remember | — | CO 2 |

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| 7 | Imagine you're a healthcare researcher developing a diagnostic model for a particular disease based on patient characteristics and medical tests. What features or diagnostic indicators would you consider in your logistic regression model, and how would you interpret the model's coefficients to understand their significance in disease diagnosis? | Remember | — | CO 2 |
| 8 | Suppose you're working on a binary classification task where the classes are linearly separable. How would you choose and train a linear classification model such as Logistic Regression or Linear SVM? | Remember | — | CO 2 |
| 9 | How can we leverage multiple linear regression to analyse the relationship between multiple independent variables (square footage, number of bedrooms, number of bathrooms, and location) and the dependent variable (selling price) in order to understand the impact of these house attributes on the selling price of houses within a specific real estate market? | Remember | — | CO 2 |

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| 10 | Choose how logistic regression can be effectively employed to predict the likelihood of a patient developing a specific medical condition based on their demographic information, lifestyle factors, and medical history, aiming to aid healthcare professionals in proactive disease management and personalized treatment strategies. | Apply | — | CO 2 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | Explain in detail about Logistic Regression? | Understand | The learner will try to **recall** the concept of logistic Regression **Demonstrate** its Implementation | CO 2 |
| 2 | Explain in detail about BLUE assumptions | Understand | The learner will try to **recall** the concept of BLUE **identify** whether the assumptions are satisfied or not | CO 2 |
| 3 | What is difference between Linear Regression and Logistic Regression in detail with examples ? | Remember | — | CO 2 |
| 4 | What are the types of Linear Regression and explain them with Examples? | Remember | — | CO 2 |
| 5 | Explain Basic Decision Tree Algorithm? | Understand | The learner will try to **recall** the concept of Basic Decision Tree Algorithm and then **Demonstrate** the usage of Algorithm | CO 2 |
| 6 | Explain how Hypothesis Search is carried out in Decision Tree Learning? | Understand | The learner will try to **recall** the concept of Hypothesis Search then **Demonstrate** the usage of Hypothesis space in Decision Tree Learning | CO 2 |

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| 7 | Explain ID3 Algorithm with an example | Understand | The learner will try to **recall** the concept of ID 3 Algorithm then **Demonstrate** the implementation | CO 2 |
| 8 | Explain in detail about Information gain and Gini Index with Example | Understand | The learner will try to **recall** the concept of then Information gain and Gini Index**Demonstrate** the implementation | CO 2 |
| 9 | Define Residual and Explain how it can be handled in Linear Regression | Remember | — | CO 2 |
| 10 | Why do we square the residuals instead of using modulus? | Remember | — | CO 2 |
| 11 | What is the Importance of SSE in Linear Regression | Remember | — | CO 2 |
| 12 | Explain the normal form equation of the Linear Regression. | Understand | The learner will try to **recall** the definition of Linear Regression and then **demonstrate** the usage of normal form equation | CO 2 |
| 13 | Explain in detail about CART Algorithm | Understand | The learner will try to **recall** the concept of CART Algorithm and then **demonstrate** the implementation | CO 2 |
| 14 | How do you learn a class from examples to perform Supervised Learning | Understand | The learner will try to **recall** the definitions and limitations of supervised and unsupervised learning and then **identify** compare them | CO 2 |
| 15 | Explain the difference between Multi-class and Multi-Label Classification | Understand | The learner will try to **recall** the definitions and limitations of Multi-class and Multi-Label Classification and then **identify** and compare them | CO 2 |
| 16 | How do Classification and Regression differ? | Remember | — | CO 2 |

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| 17 | What are the five popular algorithms we use in Machine Learning? | Remember | — | CO 2 |
| 18 | Explain the importance of Pruning? | Understand | The learner will try to **recall** Pruning and then **identify** the methods to implement it | CO 2 |
| 19 | What is a model selection in Machine Learning? | Remember | — | CO 2 |
| 20 | Explain in detail about Multiple Linear Regression and also Discuss the parameters used to assess this Regression | Understand | The learner will try to **recall** Multiple Linear Regression and then **identify** the parameters to assess this Regression | CO 2 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | What is Supervised Learning with example? | Remember | — | CO 2 |
| 2 | What are the types of Supervised Learning? | Remember | — | CO 2 |
| 3 | What are the examples of Supervised Learning Algorithms? | Remember | — | CO 2 |
| 4 | What is classification in Supervised Learning? | Remember | — | CO 2 |
| 5 | What is Linear and Non-Linear Classifier? | Remember | — | CO 2 |
| 6 | What is Multi-Class Classification problem? | Remember | — | CO 2 |
| 7 | How do you do Multi-Label Classification? | Remember | — | CO 2 |
| 8 | What is the difference between Multi-Class and Multi-Label Classification? | Remember | — | CO 2 |
| 9 | Explain Decision Tree with example? and What is Supervised Learning | Understand | The learner will try to **recall** the definition of Supervised Learning and then **demonstrate** the usage of Decision Tree Algorithm | CO 2 |
| 10 | What is Decision Tree? | Remember | — | CO 2 |
| 11 | What are the common ways to handle missing data in a dataset? | Remember | — | CO 2 |

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| 12 | Define Precision and Recall? | Remember | — | CO 2 |
| 13 | What do you understand by Decision Tree in Machine Learning? | Remember | — | CO 2 |
| 14 | What are the functions of Supervised Learning? | Remember | — | CO 2 |
| 15 | What are the functions of Unsupervised Learning? | Remember | — | CO 2 |
| 16 | What do you understand by Algorithm Independent Machine Learning? | Remember | — | CO 2 |
| 17 | Illustrate the classifier in Machine Learning | Understand | The learner will try to **recall** the concept of different Classifiers and then **Demonstrate** their usage in Learning algorithm | CO 2 |
| 18 | What according to you, is more important between Model accuracy and Model performance? | Remember | — | CO 2 |
| 19 | What do you understand by the Confusion Matrix? | Remember | — | CO 2 |
| 20 | Explain True Positive, True Negative, False Positive, and False Negative in Confusion Matrix with an example. | Understand | The learner will try to **recall** the concept of True positives and false positives and then **Demonstrate** the ways to identify them | CO 2 |
| **MODULE III** | | | | |
| **ENSEMBLE AND PROBABILISTIC LEARNING** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |
| 1 | Given a dataset with a mixture of categorical and numerical features, which ensemble learning algorithm would you choose and why? | Remember | — | CO 3 |
| 2 | Compare and contrast bagging and boosting techniques in ensemble learning. When would you prefer one over the other? | Understand | The learner will try to **recall** the concept of bagging and boosting and **demonstrate** their usages based on the situation. | CO 3 |

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| 3 | Identify a real-world problem where ensemble learning could be beneficial. Discuss how you would approach solving this problem using ensemble methods, including data preprocessing, model selection, and evaluation. | Apply | The learner will try to **recall** the concept of ensemble learning and then **demonstrate** it's real world applications. | CO 3 |
| 4 | Random Forest is known for its scalability and efficiency, but it can still be computationally expensive for very large datasets. Explain strategies for improving the scalability and efficiency of Random Forest on large datasets. | Understand | The learner will try to **recall** the concept of random forest and then **demonstrate** it's strategies for improving the scalability and efficiency on large datasets. | CO 3 |
| 5 | A marketing company is developing a predictive model to identify potential customers who are likely to respond positively to a new product campaign. The dataset includes various features such as demographic information, past purchasing behaviour, and engagement with previous marketing campaigns. The goal is to build a classification model that accurately predicts whether a customer will respond positively (positive class) or not (negative class) to the new campaign. Plan How would you utilize AdaBoost to address the marketing company's problem of predicting customer responses to the new product campaign? | Apply | The learner will try to **build** a classification model and then **solve** the problem using AdaBoost technique. | CO 3 |

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| 6 | Compare and contrast Bayesian Learning with other machine learning paradigms, such as neural networks, decision trees, or support vector machines, in terms of interpretability, robustness, and generalization performance. | Understand | The learner will try to **recall** different learning algorithms and **show** the differences between them. | CO 3 |
| 7 | Discuss how Bayesian Belief Networks can be utilized to address the healthcare organization's problem of diagnosing the medical condition based on patients' symptoms and medical history. Outline the steps involved in constructing a Bayesian Belief Network, including defining nodes, specifying conditional probability distributions, and performing inference. | Understand | The learner will try to **recall** the concept of Bayesian Belief Networks and then **solve** the given problem | CO 3 |
| 8 | An e-commerce platform wants to develop a model to classify customer inquiries into different categories, such as product inquiries, billing issues, and shipping inquiries. The dataset consists of customer messages and their corresponding categories. The goal is to build a classification model that automatically assigns the correct category to incoming customer inquiries. Utilize the Naïve Bayes Classifier to address the e-commerce platform's problem of categorizing customer inquiries into different categories. | Apply | The learner will try to **build** a classification model and then **apply** the Naïve Bayes Classifier to address the problem. | CO 3 |

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| 9 | A retail chain wants to analyse customer transaction data to discover frequent purchasing patterns and associations among products. The dataset contains records of customer transactions, including the items purchased in each transaction. The goal is to identify frequent item sets and association rules that can help the retail chain understand customer purchasing behaviour and optimize product placement and promotions. Explain how you would approach the retail chain's problem of mining frequent patterns and association rules from customer transaction data. | Understand | The learner will try to **identify** frequent item sets and association rules and then **understand** customer purchasing behaviour. | CO 3 |
| 10 | Consider a real-world scenario where the Naive Bayes Classifier might be applicable. How would you preprocess the data and tune hyperparameters to optimize its performance? | Remember | — | CO 3 |
| **PART-B LONG ANSWER QUESTIONS** | | | | |
| 1 | Explain the importance of MAT Hypothesis in the context of Baye's Theorem | Understand | The learner will try to **recall** the significance of MAT Hypothesis and then **identify** the Hypothesis in the context of Baye's Theorem | CO 3 |
| 2 | Explain in detail Bayesian Beleif Networks | Understand | The learner will try to **recall** the concept of Bayesian Beleif Network and then **Demonstrate** its implementation | CO 3 |
| 3 | What are the Applications of Minimization and Maximization Problems? | Remember | — | CO 3 |

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| 4 | What is Bias-Variance Trade off? How a learning Algorithm is Biased for a Learning Algorithm? | Remember | — | CO 3 |
| 5 | Explain Model combination Schemes in detail | Understand | The learner will try to **recall** the concept of Model Combination and then **demonstrate** the usage | CO 3 |
| 6 | Explain in detail about Maximum Likelihood and Least squared Error Hypothesis | Understand | The learner will try to **recall** the concept of Maximum Likelihood and Least squared Error Hypothesis and then **Demonstrate** the Implementation | CO 3 |
| 7 | What is Baye's rule? Define formal Description of Bayesian Interference? | Remember | — | CO 3 |
| 8 | How do you define parameters of a statistical model using Maximum Likelihood Estimation? | Remember | — | CO 3 |
| 9 | What is Bagging and Boosting? Discuss different implementation Algorithms | Remember | — | CO 3 |
| 10 | Explain in detail about Naive's Classifier | Understand | The learner will try to **recall** the concept of Naive's Classifier and then **Demonstrate** the Implementation | CO 3 |
| 11 | Explain Voting and Stacking in Detail | Understand | The learner will try to **recall** the concept of Voting and then **demonstrate** the usage | CO 3 |
| 12 | What is Error Correction? How do you perform error correcting output codes | Remember | — | CO 3 |
| 13 | Explain the log likelihood for a Multi-Nominal sample | Understand | The learner will try to **recall** the method to use log likelihood for a multi nominal sample and then **demonstrate** the usage | CO 3 |

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| 14 | Explain in detail about Gibb's Algorithm | Understand | The learner will try to **recall** the concept of Gibb's Algorithm and then **demonstrate** its implementation | CO 3 |
| 15 | Summarize the similarities and differences between bagging and boosting in Machine Learning? | Understand | The learner will try to **recall** the definition of Bagging and Boosting and then **demonstrate** their differences and similarities | CO 3 |
| 16 | Explain Bayesian Learning? | Understand | The learner will try to **recall** the definition of Bayesian Learning and then **demonstrate** their application in Real life | CO 3 |
| 17 | Explain in detail about Random Forest Trees | Understand | The learner will try to **recall** the concept Random Forest Tree and then **demonstrate** their implementation | CO 3 |
| 18 | Explain in detail about Minimum Description Length Principle | Understand | The learner will try to **recall** the concept of Minimum Description Length Principle and then **demonstrate** implementation | CO 3 |
| 19 | Explain in detail about Baye's Optimal Classifier | Understand | The learner will try to **recall** the concept of Baye's Optimal Classifier and then **demonstrate** its application in Machine Learning | CO 3 |
| 20 | Explain how Maximum Likelihood Hypothesis helps in predicting Probabilities | Understand | The learner will try to **recall** concept of Maximum Likelihood Hypothesis and its set of problems then **demonstrate** the usage | CO 3 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | What is Bayesian Expected Loss? | Remember | — | CO 3 |
| 2 | What is Structural Risk Minimization? | Remember | — | CO 3 |
| 3 | What is Interpolation and Extrapolation? | Remember | — | CO 3 |

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| 4 | What is Parametric Formulation? | Remember | — | CO 3 |
| 5 | Define Binary and Multi-Class Classification? | Remember | — | CO 3 |
| 6 | What is a Linear Predictor Function? | Remember | — | CO 3 |
| 7 | Find the log likelihood for a Multi-nomial sample | Remember | — | CO 3 |
| 8 | Define Voting | Remember | — | CO 3 |
| 9 | Define Stacked Generalization | Remember | — | CO 3 |
| 10 | How do you generate Diverse Learners ? | Remember | — | CO 3 |
| 11 | Define Weak learner and Strong Learner | Remember | — | CO 3 |
| 12 | What is 'Naive' in a Naive Bayes? | Remember | — | CO 3 |
| 13 | Define Unstable Algorithm | Remember | — | CO 3 |
| 14 | What is Cross-Validation? | Remember | — | CO 3 |
| 15 | What is Bias in Machine Learning? | Remember | — | CO 3 |
| 16 | What are Loss Function and Cost Functions? Explain the key Difference Between them? | Remember | — | CO 3 |
| 17 | What is Code Matrix ? | Remember | — | CO 3 |
| 18 | Define Ensembles and Linear opinion tools | Remember | — | CO 3 |
| 19 | What are Parametric and Non-Parametric Models? | Remember | — | CO 3 |
| 20 | Define Multi-expert and Multi-stage combinations | Remember | — | CO 3 |
| **MODULE IV** | | | | |
| **UNSUPERVISED LEARNING** | | | | |
| **PART A- PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS** | | | | |

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| 1 | An educational institution wishes to improve its teaching methods by understanding the diverse learning patterns among its students. The institution has data on students' grades, participation in extracurricular activities, and feedback on teaching methods. Plan an approach using hierarchical clustering to discern patterns in student achievement, and discuss how these insights might inform the customization of instructional strategies. | Apply | — | CO 4 |
| 2 | An online streaming platform wants to enhance its recommendation engine by clustering users based on their viewing habits and preferences. Outline a strategy for using hierarchical clustering to achieve this goal. | Understand | — | CO 4 |
| 3 | K-means clustering iteratively updates cluster centroids to minimize the within-cluster sum of squares (WCSS). What conditions might lead to the algorithm converging to a local minimum rather than the global minimum, and how can this issue be mitigated? | Remember | — | CO 4 |
| 4 | K-means clustering works well with numerical data. How would you modify the k-means algorithm or preprocess data to cluster datasets with categorical features? | Remember | — | CO 4 |

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| 5 | A social media company wishes to understand user behaviour by clustering users based on their interactions (e.g., likes, shares, comments) across different types of content (e.g., posts, photos, videos). Illustrate how K-mode clustering can be applied to categorize users into distinct profiles, and discuss potential insights that could be gained from these clusters. | Understand | — | CO 4 |
| 6 | An AI startup is developing an application that requires compressing large sets of images without significantly losing visual information. Explain how PCA can be employed to reduce the size of the image data while retaining essential features necessary for image recognition or classification tasks. | Understand | — | CO 4 |
| 7 | Neuroscientists are studying brain activity patterns using fMRI data to understand cognitive processes. The high dimensionality of fMRI data makes it challenging to analyse. Explain how PCA can be applied to reduce the dimensionality of brain imaging data, facilitating the identification of brain regions involved in different cognitive functions. | Understand | — | CO 4 |

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| 8 | LLE (Locally Linear Embedding) has been applied in various fields, from face recognition to bioinformatics. Choose an application of LLE and discuss how its properties benefit that particular application. Are there any limitations of LLE that might affect its effectiveness in this application? | Remember | — | CO 4 |
| 9 | Both AGNES and DIANA construct a dendrogram representing the hierarchical cluster structure. How would you determine the optimal number of clusters using the dendrogram? Discuss any methods or criteria that could be applied. | Remember | — | CO 4 |
| 10 | Discuss how AGNES and DIANA handle noise and outliers in the data. Which of the two methods is more sensitive to outliers, and why? How can this sensitivity impact the interpretation of the resulting hierarchical structure? | Remember | — | CO 4 |

| PART-B LONG ANSWER QUESTIONS | | | | |
|---|---|---|---|---|
| 1 | What is the relationship between PCA and K-Means Clustering? | Remember | — | CO4 |
| 2 | How to find the best subset of selection of features? | Remember | — | CO 4 |
| 3 | What are the similarities and Differences between Avererage link clustering and K- Means | Remember | — | CO 4 |
| 4 | How is Dimension Reduction performed on High Dimension Data? | Remember | — | CO 4 |
| 5 | Explain the K-Means Algorithm for the given data set? | Understand | The learner will try to **recall** K means Algorithm **Demonstrate** the usage of algorithm | CO 4 |
| 6 | Explain Principal Component Analysis for the given sample? | Understand | The learner will try to **recall** the concept of Principle component Analysis and **Demonstrate** its application | CO 4 |
| 7 | Explain AGNES Algorithm in detail. | Understand | The learner will try to **recall** the concept AGNES Algorithm and **Demonstrate** its application | CO 4 |
| 8 | Explain DIANA Algorithm in detail. | Understand | The learner will try to **recall** the concept of DIANA Algorithm and **demonstrate** its application | CO 4 |
| 9 | Explain Partitional Clustering Algorithm in detail | Understand | The learner will try to **recall** the concept of Partitional Clustering and **Demonstrate** its usage | CO 4 |
| 10 | Define Dendograms. can we prune Dendograms. | Understand | The learner will try to **recall** the concept of Dendogram and **identify** whether it can be pruned or not | CO 4 |

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| 11 | Explain K-Mode Clustering Algorithm in detail | Understand | The learner will try to **recall** the concept of K-Mode Clustering and **Demonstrate** it on the given sample | CO 4 |
| 12 | Explain about Self Organizing Maps (SOM) | Understand | The learner will try to **recall** the concept of SOM and **demonstrate** its application in Marketing Research | CO 4 |
| 13 | What do you mean by mixture Densities? Explain the need of it in Clustering. | Understand | The learner will try to **recall** the concept of mixture density and **Demonstrate** its application in clustering | CO 4 |
| 14 | Describe about Expectation-Maximization Algorithm in detail | Understand | The learner will try to **recall** the concept of Expectation-Maximization and **Demonstrate** it in detail | CO 4 |
| 15 | Explain in detail about Supervised Learning and Clustering | Understand | The learner will try to **recall** the concept of Supervised Learning and clustering and **Demonstrate** its differences | CO 4 |
| 16 | How do you choose the number of clusters to perform Clustering ? | Remember | — | CO 4 |
| 17 | What do you mean by Dimensionality Reduction ? Explain about Isomap? | Remember | — | CO 4 |
| 18 | Explain about Locally Linear Embedding Process in detail | Understand | The learner will try to **recall** the concept of locally Linear Embedding and **demonstrate** its application | CO 4 |
| 19 | Explain in detail about Factor Analysis | Understand | The learner will try to **recall** the concept of Factor Analysis and **Demonstrate** its application | CO 4 |

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| 20 | Explain the importance of Subset selection in Dimensionality Reduction | Understand | The learner will try to **recall** the significance subset selection and **demonstrate** its application | CO 4 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define Dimensionality Reduction? | Remember | — | CO 4 |
| 2 | How is Dimension Reduction performed on high Dimension Data? | Remember | — | CO 4 |
| 3 | What are reference Vectors in K-Means Clustering | Remember | — | CO 4 |
| 4 | Define Reconstruction Error | Remember | — | CO 4 |
| 5 | What do you mean by Mixtures of Latent Variable Models | Remember | — | CO 4 |
| 6 | Define Principal Component Analysis ? | Remember | — | CO 4 |
| 7 | How is PCA useful in orthogonal transformation? | Remember | — | CO 4 |
| 8 | How to Compute PCA using Covariance Method? | Remember | — | CO 4 |
| 9 | How to compute Co-Variance Matrix? | Remember | — | CO 4 |
| 10 | Define Factor Analysis? | Remember | — | CO 4 |
| 11 | Define Density Estimation | Remember | — | CO 4 |
| 12 | Define Semi-Parametric Density Estimation | Remember | — | CO 4 |
| 13 | Define Mixture Density | Remember | — | CO 4 |
| 14 | Define Color Quantization | Remember | — | CO 4 |
| 15 | Define Vector Quantization | Remember | — | CO 4 |
| 16 | Define Compression | Remember | — | CO 4 |
| 17 | Define Code Book Vectors | Remember | — | CO 4 |
| 18 | Define Reconstruction Error | Remember | — | CO 4 |
| 19 | What do you mean by Mixture of Mixtures | Remember | — | CO 4 |
| 20 | Define Mixture Model | Remember | — | CO 4 |

| MODULE V | | | | |
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| **ADVANCED SUPERVISED LEARNING** | | | | |
| **PART A-PROBLEM SOLVING AND CRITICAL THINKING QUESTIONS)** | | | | |
| 1 | Perceptron's are commonly used for binary classification tasks. How would you extend a perceptron to handle multiclass classification? Discuss the challenges involved and potential approaches to address them. | Remember | — | CO 5 |
| 2 | Compare and contrast the capabilities and limitations of perceptrons with other machine learning models, such as support vector machines (SVMs) or decision trees. | Understand | The learner will try to **Recall** the concept of Perceptron and then **Compare** with other machine learning models. | CO 5 |
| 3 | Given a dataset containing information about houses, including features such as square footage, number of bedrooms, and number of bathrooms. Develop an Multi Layer Perceptron model to predict both the price and the time it will take to sell each house. | Apply | The learner will try to **Build** a MLP model and then **Solve** the given problem. | CO 5 |
| 4 | Suppose you have a dataset containing historical stock prices of a company. Build an Multi Layer Perceptron model to predict the future stock prices based on past trends and relevant market indicators. | Apply | The learner will try to **Build** a MLP model and then **Solve** the given problem. | CO 5 |
| 5 | SVM is known for its ability to provide interpretable decision boundaries. How can you interpret the decision boundary generated by an SVM model? | Remember | — | CO 5 |

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| 6 | Compare SVM with other classification models such as logistic regression, decision trees, and neural networks. In what scenarios would SVM outperform these models, and vice versa? | Understand | The learner will try to **Recall** the concept of SVM and then **Compare** with other machine learning models. | CO 5 |
| 7 | KNN relies on distance metrics to measure similarity between data points. How does the choice of distance metric (e.g., Euclidean distance, Manhattan distance, etc.) affect the performance of KNN? Provide examples where different distance metrics may be more suitable. | Remember | — | CO 5 |
| 8 | You've trained a KNN classifier. How do you evaluate its performance? | Remember | — | CO 5 |
| 9 | KNN traditionally works with numerical features. How would you handle categorical features in KNN? | Remember | — | CO 5 |
| 10 | ANNs are prone to overfitting, especially when dealing with complex models and limited training data. How can you prevent overfitting in ANNs? | Remember | — | CO 5 |

| PART-B LONG ANSWER QUESTIONS | | | | |
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| 1 | Define Neural Network and Explain how it resembles human brain | Remember | — | CO 5 |
| 2 | Explain the concept of Bayesian View of Learning in Neural Networks | Understand | The learner will try to **recall** the concept of Bayesian View of Learning and then **Demonstrate** its usage in neural networks | CO 5 |
| 3 | How Neural Network supports parallel processing | Remember | — | CO 5 |
| 4 | What do you mean by Perceptron and explain its role in Neural Network | Remember | — | CO 5 |
| 5 | How do you train a Perceptron to implement Stocastic Gradie nt Decent | Understand | The learner will try to **recall** remember the concept of Stocastic Gradient Decent and then**summarize** the training on a perceptron | CO 5 |
| 6 | Explain about Multi-layer Perceptron in detail | Understand | The learner will try to **recall** remember the concept of Multi-layer Perceptron and then**summarize** the training on a perceptron | CO 5 |
| 7 | Explain in detail about Back Propagation Algorithm | Understand | The learner will try to **recall** remember the concept of Back Propagation Algorithm and then**Demonstrate** its implementation | CO 5 |
| 8 | Explain in detail about Training Procedures | Understand | The learner will try to **recall** remember Training Procedures and then**Demonstrate** its implementation | CO 5 |
| 9 | Explain in detail about K Nearest Neighbor | Understand | The learner will try to **recall** the concept of K-Nearest Neighbor and then**Demonstrate** its implementation | CO 5 |

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| 10 | Explain the Importance of Structural Adaptation in tuning the network size | Understand | The learner will try to **recall** the concept of Structural Adaptation and then**Demonstrate** its significance | CO 5 |
| 11 | Explain the use of Bayesian Approach in training Neural Networks | Understand | The learner will try to **recall** the concept of Bayesian Approach and then**Demonstrate** its implementation | CO 5 |
| 12 | Explain the importance of Sammon Mapping in reducing Dimensions in a Neural Network | Understand | The learner will try to **recall** the concept of Sammon Mapping and then**Demonstrate** its implementation on reduced dimension | CO 5 |
| 13 | Explain in detail about Time Delay Neural Networks | Understand | The learner will try to **recall** the concept of Time Delay Neural Networks and then**Demonstrate** its implementation | CO 5 |
| 14 | Explain the importance of recurrent Methods | Understand | The learner will try to **recall** the concept of Recurrent Methods and then**Demonstrate** its implementation | CO 5 |
| 15 | Describe about Kernel Machines and Explain its importance in detail | Understand | The learner will try to **recall** the concept of Kernel Machine and then **demonstrate** its significance | CO 5 |
| 16 | What do you mean by Hyper Plane and Explain about Optimal Seperating Hyperplane | Understand | The learner will try to **recall** the concept of Hyperplane and then **demonstrate** the definition of Optimal Seperating Hyperplane | CO 5 |
| 17 | Describe in detail about Soft Margin Hyperplane | Understand | The learner will try to **recall** the concept of soft margin Hyperplane and then **demonstrate** it in detail | CO 5 |

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| 18 | Describe the importance of Kernel Trick in mapping non-linear model to Linear Model | Understand | The learner will try to **recall** the concept of kernel trick and then **demonstrate** the way of mapping non-linear and Linear Model | CO 5 |
| 19 | Explain various general purpose Kernel Functions | Understand | The learner will try to **recall** the concept of Kernel Function and then **demonstrate** the implementation | CO 5 |
| 20 | Describe in detail about constructing a new kernel by combining various kernels | Understand | The learner will try to **recall** the concept of constructing a new kernel and **demonstrate** the ways of combining various kernels | CO 5 |
| **PART-C SHORT ANSWER QUESTIONS** | | | | |
| 1 | Define Neuron | Remember | — | CO 5 |
| 2 | Define Synapses | Remember | — | CO 5 |
| 3 | Define Single Instruction Multiple Data(SIMD) Machines | Remember | — | CO 5 |
| 4 | Define Multiple Instruction Multiple Data(MIMD) Machines | Remember | — | CO 5 |
| 5 | Define Neural Instruction Multiple Data(NIMD) Machines | Remember | — | CO 5 |
| 6 | Define Synaptic Weight | Remember | — | CO 5 |
| 7 | Define Threshold Function | Remember | — | CO 5 |
| 8 | Define Stocastic Gradient Decent | Remember | — | CO 5 |
| 9 | What do you mean by Universal Approximation ? | Remember | — | CO 5 |
| 10 | Explain about Piece-wise Constant Approximation | Understand | The learner will try to **recall** the concept of approximation and **demonstrate** the ways of implementing Piece-wise Constant Approximation | CO 5 |

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| 11 | Explain how Back Propagation Supports Batch Learning in brief | Understand | The learner will try to **recall** the concept of Back Propagation and then **demonstrate** the ways of implementing it with Batch Learning | CO 5 |
| 12 | Define Epoch | Remember | — | CO 5 |
| 13 | How do you improve convergence? | Remember | — | CO 5 |
| 14 | What do you mean by Adaptive Learning Rate | Remember | — | CO 5 |
| 15 | Define Momentum | Remember | — | CO 5 |
| 16 | What do you mean by Over-Training ? | Remember | — | CO 5 |
| 17 | How do you perform Structural Adaptation | Remember | — | CO 5 |
| 18 | Define Weight Decay | Remember | — | CO 5 |
| 19 | Define Radial Basis Function | Remember | — | CO 5 |
| 20 | What do you mean by Hinge laws? | Remember | — | CO 5 |
| 21 | Define Sigmoidal Functions | Remember | — | CO 5 |
| 22 | How do you perform Out-Lier Detection? | Remember | — | CO 5 |

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**HOD CSE(AI & ML)**