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**Printed Page:-4** **Subject Code:- BEC0512**

**Roll. No:**

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**NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA**
**(An Autonomous Institute Affiliated to AKTU, Lucknow)**
**B.Tech**
**SEM: V - THEORY EXAMINATION (2025 - 2026)**
**Subject: Machine Learning**

**Time: 3 Hours** **Max. Marks: 100**

**General Instructions:**

**IMP:** *Verify that you have received the question paper with the correct course, code, branch etc.*

***1.*** *This Question paper comprises of* ***three Sections -A, B, & C.*** *It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.*

***2.*** *Maximum marks for each question are indicated on right -hand side of each question.*

***3.*** *Illustrate your answers with neat sketches wherever necessary.*

***4.*** *Assume suitable data if necessary.*

***5.*** *Preferably, write the answers in sequential order.*

***6.*** *No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.*



## SECTION-A 20

1. Attempt all parts:-

1-a. Which of the following can help reduce classification bias? (CO1, K1) 1

(a) Ignoring minority class samples
(b) Increasing model regularization
(c) Using resampling methods like SMOTE or class weighting
(d) Using a simpler model

1-b. In supervised learning, the test dataset is used to: (CO1, K1) 1

(a) Train the model
(b) Tune model hyperparameters
(c) Evaluate model performance on unseen data
(d) Increase training accuracy

1-c. One major limitation of backpropagation is: (CO2, K4) 1

(a) It cannot handle nonlinear data
(b) It requires labeled data and may get stuck in local minima
(c) It always converges to global minima
(d) It does not update weights

1-d. Batch training updates weights after: (CO2, K1) 1

(a) Each input sample
(b) Each epoch
(c) A fixed number of samples
(d) Random selection

1-e. The difference between PCA and ICA lies in: (CO3, K6) 1

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(a) PCA maximizes independence while ICA maximizes variance
(b) PCA finds uncorrelated components, ICA finds independent components
(c) Both find independent components
(d) Both minimize covariance

1-f. The kernel trick in SVM is used to: (CO3, K3) 1

(a) Map data to higher-dimensional space
(b) Reduce dimensionality
(c) Normalize data
(d) Remove noise

1-g. What is the main goal of the “Going Downhill” process in machine learning? (CO4, K1) 1

(a) To minimize the cost function
(b) To maximize the number of parameters
(c) To increase regularization
(d) To avoid gradient computation

1-h. In the fractional knapsack problem, the solution can be found using: (CO4, K3) 1

(a) Dynamic programming
(b) Greedy algorithm
(c) Backtracking
(d) Branch and bound

1-i. The “Markov Property” implies that the next state depends on: (CO5, K2) 1

(a) All previous states
(b) Only the current state and action
(c) Future states
(d) Random noise

1-j. The discount factor ($\gamma$) in an MDP is used to: (CO5, K3) 1

(a) Penalize large actions
(b) Determine the importance of future rewards
(c) Compute average rewards
(d) Define the learning rate

2. Attempt all parts:-

2.a. Explain how Linear Regression predicts continuous outcomes using input features. (CO1, K3) 2

2.b. Define linear regression. (CO2, K1) 2

2.c. What challenges arise in PDA when the data classes are not linearly separable? (CO3, K4) 2

2.d. Explain why Mini-Batch Gradient Descent helps in escaping local minima during optimization. (CO4, K5) 2

2.e. Explain how entropy is used in building a Decision Tree. (CO5, K2) 2

**SECTION-B** 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

| | | |
|---|---|---|
| 3.a.(i) | Illustrate the steps involved in building a Supervised Learning model and explain how overfitting can be avoided. (CO1, K5) | 6 |
| 3.a.(ii) | Explain the steps involved in performing a hypothesis test and discuss the importance of each step. (CO1, K2) | 6 |

3.b. Answer any one of the following:-

| | | |
|---|---|---|
| 3.b.(i) | Explain the working of the back propagation algorithm with a detailed flow diagram. (CO2, K3) | 6 |
| 3.b.(ii) | Compare sequential training and batch training in terms of efficiency, accuracy, and convergence rate. (CO2, K4) | 6 |

3.c. Answer any one of the following:-

| | | |
|---|---|---|
| 3.c.(i) | Compare PCA with Linear Discriminant Analysis in terms of objectives and data interpretation. (CO3, K4) | 6 |
| 3.c.(ii) | Explain the concept of the optimal hyperplane in Support Vector Machines and how it is determined. (CO3, K4) | 6 |

3.d. Answer any one of the following:-

| | | |
|---|---|---|
| 3.d.(i) | Explain the working principle of the Greedy Search algorithm. (CO4, K1) | 6 |
| 3.d.(ii) | Compare Dynamic Programming and Greedy approaches for solving the Knapsack Problem. (CO4, K4) | 6 |

3.e. Answer any one of the following:-

| | | |
|---|---|---|
| 3.e.(i) | Explain how reinforcement learning is applied in autonomous vehicle navigation systems. (CO5, K2) | 6 |
| 3.e.(ii) | Explain the concept of a Classification and Regression Tree (CART) and how it differs from other types of decision trees. (CO5, K2) | 6 |

**SECTION-C** 50

4. Answer any one of the following:-

| | | |
|---|---|---|
| 4-a. | Analyze the impact of overfitting and underfitting in Supervised Learning models. How can techniques like cross-validation and regularization help mitigate them? (CO1, K5) | 10 |
| 4-b. | Analyze the challenges faced in Unsupervised Learning, such as determining the number of clusters and evaluating model performance. Provide suitable solutions. (CO1, K5) | 10 |

5. Answer any one of the following:-

| | | |
|---|---|---|
| 5-a. | Derive the weight and bias update rules in the back propagation algorithm and explain each term involved. (CO2, K5) | 10 |
| 5-b. | Explain the process of estimating regression coefficients in linear regression using the least squares method. (CO2, K6) | 10 |

6. Answer any one of the following:-

| | | |
|---|---|---|
| 6-a. | Discuss the limitations of PCA in handling non-linear data and propose alternative methods or extensions that can overcome these issues. (CO3, K6) | 10 |
| 6-b. | Compare different types of kernel functions (linear, polynomial, RBF, and sigmoid) in terms of formulation, advantages, and applications. (CO3, K4) | 10 |

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7. Answer any <u>one</u> of the following:-

| | | |
|---|---|---|
| 7-a. | Discuss the role of stochasticity in SGD and explain how it helps in generalization and avoiding local minima. (CO4, K5) | 10 |
| 7-b. | Discuss the effect of mutation and crossover rates in the Genetic Algorithm's convergence and solution diversity. (CO4, K5) | 10 |

8. Answer any <u>one</u> of the following:-

| | | |
|---|---|---|
| 8-a. | Design a small dataset and demonstrate step-by-step how CART can be used for both classification and regression tasks. Include splitting, pruning, and evaluation. (CO5, K6) | 10 |
| 8-b. | Discuss how the value of K (number of clusters) affects the performance of the K-Means algorithm. Explain methods like the Elbow Method and Silhouette Score for choosing optimal K. (CO3, K4) | 10 |