18365

BRAINWARE UNIVERSITY

Term End Examination 2025-2026
Programme – M.Tech.(CSE)-2025
Course Name – Mathematics for Machine Learning
Course Code - MTS10401
(Semester I)

Full Marks : 60 **Time : 2:30 Hours**

[The figure in the margin indicates full marks. Candidates are required to give their answers in their own words as far as practicable.]

Group-A

(Multiple Choice Type Question) 1 x 15=15

1. *Choose the correct alternative from the following :*

(i) Select the fundamental branch of mathematics that supports gradient-based learning algorithms.

a) Calculus b) Algebra
c) Geometry d) Probability

(ii) Select the matrix property that allows solving a system of linear equations uniquely.

a) Symmetry b) Determinant ≠ 0
c) Skew-symmetry d) Trace = 0

(iii) Select the eigenvalues is essential of the following ML techniques.

a) Linear Regression b) Principal Component Analysis
c) K-Means Clustering d) Decision Trees

(iv) Select the gradient vector helps in determining:

a) Direction of maximum decrease b) Direction of maximum increase
c) Local minimum d) Global maximum

(v) Select the best approach for minimizing cost functions in high-dimensional spaces.

a) Brute force b) Symbolic computation
c) Gradient descent d) Decision trees

(vi) Choose the appropriate domain for spectral analysis in ML.

a) Frequency b) Time
c) Probability d) Position

(vii) Identify the technique that transforms correlated variables into uncorrelated ones.

a) Clustering b) PCA
c) Naïve Bayes d) Normalization

(viii) Select the residuals is crucial for evaluating:

a) Variance b) Covariance
c) Model fit d) Entropy

(ix) Choose the derivative of a cost function with respect to weights in a neural net.

a) Learning rate
b) Error term
c) Gradient
d) Activation

(x) Select the Hessian matrix helps in identifying:

a) Linear regions
b) Direction of descent
c) Local minima/maxima
d) Feature scaling

(xi) Choose the derivative of the sigmoid function at input zero.

a) 1
b) 0.25
c) 0.5
d) 0

(xii) Choose the best method to select features with high variance.

a) Lasso
b) Variance Threshold
c) PCA
d) Correlation Matrix

(xiii) Identify the function that computes the probability distribution over classes.

a) Sigmoid
b) Step
c) Softmax
d) Tanh

(xiv) Choose the technique that chooses the most relevant features automatically.

a) Cross-validation
b) Feature engineering
c) L1 regularization
d) Batch normalization

(xv) Select the matrix property helps determine invertibility.

a) Trace
b) Rank
c) Skew
d) Shape

Group-B

(Short Answer Type Questions) 3 x 5=15

2. State a description of a vector space. (3)
3. Summarize a description of L2 regularization. (3)
4. Evaluate the utility of cosine similarity in text classification. (3)
5. Explain the curse of dimensionality. (3)
6. Analyze the benefit of using normalized vectors in similarity computations. (3)

OR

Analyze the stochastic gradient descent (SGD). (3)

Group-C

(Long Answer Type Questions) 5 x 6=30

7. State the role of the dot product in similarity computation. (5)
8. Analyze the use of the chain rule in deep learning backpropagation. (5)
9. Explain the role of entropy in machine learning. (5)
10. Evaluate the importance of transformation techniques in feature engineering. (5)
11. Analyze the impact of high-dimensional data on machine learning algorithms. (5)
12. Analyze the mathematical formulation of Support Vector Machines (SVMs). (5)

OR

Analyze the use of probabilistic graphical models in machine learning. (5)

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