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VIVEKANANDHA COLLEGE OF ENGINEERING FOR WOMEN
[AUTONOMOUS INSTITUTION AFFILIATED TO ANNA UNIVERSITY, CHENNAI]
Elayampalayam – 637 205, Tiruchengode, Namakkal Dt., Tamil Nadu.

Question Paper Code: 130012

B.E. / B.Tech. DEGREE END-SEMESTER EXAMINATIONS – NOV. / DEC. 2025
Seventh Semester
Computer Science and Technology
U19CTV31 – PATTERN RECOGNITION TECHNIQUES
(Regulation 2019)

Time: Three Hours

Maximum: 100 Marks

Answer ALL the questions

Knowledge Levels (KL)	K1 – Remembering	K3 – Applying	K5 - Evaluating
	K2 – Understanding	K4 – Analyzing	K6 - Creating

PART – A

(10 x 2 = 20 Marks)

Q.No.	Questions	Marks	KL	CO
1.	State the condition for two events to be statistically independent with an example.	2	K2	CO1
2.	Differentiate between a stationary and a non-stationary random process.	2	K2	CO1
3.	State Bayes' decision rule for two-class classification.	2	K2	CO2
4.	State the core objective of the minimum-error-rate classification rule.	2	K2	CO2
5.	Define pruning in the context of decision trees and explain its significance.	2	K2	CO3
6.	Describe the Hidden Markov model and its role in the classifier design.	2	K2	CO3
7.	Describe the concept known as 'curse of dimensionality'.	2	K2	CO4
8.	List the steps involved in the K-Nearest Neighbour classification algorithm.	2	K1	CO4
9.	Define the decision boundary in support vector machine and explain its purpose.	2	K2	CO5
10.	List two application of pattern recognition in fingerprint identification.	2	K1	CO5

PART – B

(5 x 13 = 65 Marks)

Q.No.	Questions	Marks	KL	CO
11. a)	Find Eigen Values and Eigen vectors of the following matrix: $A = \begin{bmatrix} -5 & 2 \\ -7 & 4 \end{bmatrix}$	13	K1	CO1
	(OR)			
b)	Given two vectors in a 3-dimensional space: $u = [2, -1, 3]$ $v = [4, 2, 1]$ Calculate the inner and outer product of vectors u and v. Compute the angle between the two vectors and determine the rank and determinant of the outer product matrix.	13	K1	CO1
12. a)	Compare and contrast the two major parameter estimation techniques: Maximum Likelihood (ML) and Maximum a Posteriori (MAP). Evaluate which technique is more suitable in case of large and small dataset.	13	K2	CO2
	(OR)			
b)	Obtain the discriminant function for Bayes' classifier if the feature vector distribution is Gaussian with different means and a fixed diagonal covariance matrix.	13	K2	CO2
13. a)	Explain the principles of unsupervised learning. Differentiate between Hard Clustering and Soft Clustering approaches. Support your answer with a clear example for each, showing how data points are assigned to clusters in both methods.	13	K2	CO3
	(OR)			
b)	Explain the steps in Expectation-Maximization method for parameter estimation.	13	K1	CO3
14. a)	Explain the Parzen window method for density estimation.	13	K2	CO4
	(OR)			
b)	Define Dimensionality Reduction in the context of machine learning and data analysis. Explain why dimensionality reduction is important when working with high-dimensional datasets. Describe commonly used techniques for dimensionality reduction, distinguishing between: <ul style="list-style-type: none"> • Feature Selection methods (e.g., filter, wrapper, embedded methods) • Feature Extraction methods (e.g., PCA, LDA, t-SNE, Autoencoders) For each technique, explain how it works and give a suitable example of its application.	13	K2	CO4

15. a) i. Illustrate the working principle of the Perceptron Learning Algorithm. 8 K1 CO5
 In your explanation, include the model representation, update rule, and a step-by-step process showing how the algorithm learns from misclassified examples.
- ii. State and explain the Perceptron Convergence Theorem. 5
 Under what conditions does the theorem guarantee convergence of the algorithm?
- (OR)
- b) Describe the CART (Classification and Regression Trees) algorithm for building a decision tree. 13 K2 CO5

PART – C

(1 x 15 = 15 Marks)

- | Q.No. | Questions | Marks | KL | CO |
|--------|--|-------|----|-----|
| 16. a) | You are given a small dataset consisting of three data points with two features, $x_1 \times 1$ and $x_2 \times 2$, as shown below: | 15 | K1 | CO1 |

X1	1	3	5
X2	2	4	6

Using Principal Component Analysis (PCA), determine the first principal component (PC1) for this dataset.

Clearly show the steps involved:

- Centering the dataset (subtracting the mean).
- Computing the covariance matrix.
- Finding the eigenvalues and eigenvectors.
- Identifying the eigenvector corresponding to the largest eigenvalue (i.e., PC1).

(OR)

- b) The K-means clustering algorithm is one of the most widely used unsupervised learning techniques for partitioning data into groups based on similarity. 15 K3 CO3
- Provide a detailed analysis of the K-means algorithm by discussing its strengths (advantages) and weaknesses (limitations).
 - Propose a real-world scenario or application domain where K-means would serve as an ideal choice for clustering. Clearly explain why this algorithm is well-suited for the chosen scenario, supporting your reasoning with relevant points such as data characteristics, efficiency, or simplicity.