

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER- VII EXAMINATION – SUMMER 2026

Subject Code:3171613

Date:22-05-2026

Subject Name: Pattern Recognition

Time: 02:30 PM TO 05:00 PM

Total Marks:70

Instructions:

1. Attempt all questions.
2. Make suitable assumptions wherever necessary.
3. Figures to the right indicate full marks.
4. Simple and non-programmable scientific calculators are allowed.

		MARKS
Q.1	(a) State Bayes Theorem and explain its significance.	03
	(b) Difference between joint probability and conditional probability	04
	(c) Explain of Autocorrelation, Cross-Correlation, and spectra in brief.	07
Q.2	(a) Explain eigenvalues and eigenvectors in brief.	03
	(b) Explain the concept of a discriminant function in classification.	04
	(c) Explain the steps in “k-means clustering” using a suitable illustration. List out limitations of “k-means clustering”.	07
	OR	
	(c) Discuss the principles and applications of nonparametric techniques for density estimation, focusing on the K-Nearest Neighbors (K-NN) method. Provide examples of how K-NN can be employed in practice.	07
Q.3	(a) Define Maximum-Likelihood Estimation (MLE) in the context of the Gaussian case.	03
	(b) Describe the key differences between Bayesian estimate and maximum likelihood estimation.	04
	(c) Explain Hidden Markov model (HMMs) and its role in the classifier design.	07
	OR	
Q.3	(a) Define the criterion function used in K-Means clustering.	03
	(b) Describe the key differences between Maximum a Posteriori (MAP) estimation and Maximum-Likelihood Estimation (MLE).	04
	(c) Explain the Expectation-Maximization (EM) algorithm in the context of Gaussian Mixture Models (GMMs) and demonstrate how it can be used to estimate the parameters of a GMM.	07
Q.4	(a) Describe the main objective of Factor Analysis.	03
	(b) Explain Fisher Discriminant Analysis (FDA) in the context of supervised dimensionality reduction.	04
	(c) Explain in detail the “Principal Component Analysis” method for dimensionality reduction.	07
	OR	
Q.4	(a) Define Principal Component Analysis (PCA) and its purpose in dimensionality reduction.	03
	(b) Compare and contrast eigenvalues and singular vectors as dictionaries for data representation.	04
	(c) Analyze the role of dictionary learning methods, such as factor analysis and non-negative matrix factorization, in capturing latent	07

features and reducing data dimensionality.

- Q.5**
- (a)** Define linear discriminant functions and their role in classification. **03**
 - (b)** State the main idea behind Support Vector Machines (SVM) for binary classification. **04**
 - (c)** Explain Decision Tree learning based on the Classification and Regression Trees (CART) approach with example. **07**
- OR**
- Q.5**
- (a)** Define nominal data in the context of pattern classification. **03**
 - (b)** Define Gradient Descent, and how is it used in optimizing linear discriminant functions. **04**
 - (c)** Discuss multilayer feed-forward neural networks with neat architecture diagram **07**