

GUJARAT TECHNOLOGICAL UNIVERSITY

BE- SEMESTER-VII EXAMINATION – WINTER 2025

Subject Code:3171613

Date:15-11-2025

Subject Name:Pattern Recognition

Time:10:30 AM TO 01:00 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) Define the following terms: conditional probability, joint probability and independent events. **03**
- (b) Find inner product and outer product of following two vectors U and V, where $U = [2 \ 7 \ 5 \ 6]$ and $V = [4 \ 1 \ 7 \ 2]$ **04**
- (c) (1) Suppose we are rolling a fair dice. The possible outcomes are 1, 2, 3, 4, 5 and 6. Let random variable X represent the outcomes. Calculate the expected value of X i.e $E[X]$? **07**
- (2) Suppose a bag has total 10 balls. Out of 10 balls, 6 are red, 3 are blue and 1 is green. Consider following events A and B. Calculate conditional probability $P(A|B)$.
- Event A: Drawing a red ball from the bag.
Event B: Drawing a ball that is not green.
- (3) Define : Autocorrelation
- Q.2**
- (a) State for each problem, whether it belongs to supervised learning or unsupervised learning or none of the two ? **03**
1. Predict disease from blood sample
 2. Group audio files based on language of speakers
 3. Face Recognition to unlock mobile phone
 4. Predict sales of a product
 5. Group applicants for a job as per their nationality
 6. Learning to play chess
- (b) Consider two class classification problem. The classes are denoted as w_1 and w_2 . Apply Baye's minimum risk classification rule to decide whether sample x belongs to class w_1 or w_2 . Use the following data: **04**
- $P(w_1) = 0.6$, $P(w_2) = 0.4$, $P(x) = 0.74$, $P(x|w_1) = 0.75$, $P(x|w_2) = 0.4$. Loss parameters are: $\lambda_{11} = 0.3$, $\lambda_{12} = 0.7$, $\lambda_{21} = 0.65$, $\lambda_{22} = 0.35$.
- (c) [1] Explain the two types of states in Hidden Markov Model. **07**
 [2] Explain the two types of probabilities in Hidden Markov Model.
 [3] Explain step by step Hidden Markov Model Algorithm.

OR

- Q.3** (c) Discuss concept of Gaussian Mixture Model. **07**
(a) Assume marks obtained by students in an examination follows normal distribution. The marks obtained are : 40, 45, 50, 30, 55, 70, 83, 90, 25, 66. Find parameters of normal distribution using Maximum Likelihood Estimation. **03**
(b) Explain with an example why large dimension of dataset is not desirable ? **04**
(c) Consider the below given two dimensional dataset with two features X1 and X2. Group the records into clusters using Single Linkage Hierarchical clustering and draw the dendrogram. Use Euclidean distance. **07**

Sr. No.	X1	X2
S1	4	3
S2	1	4
S3	2	1
S4	3	8
S5	6	9
S6	5	1

OR

- Q.3** (a) What do you mean by parameter estimation ? Explain Bayesian estimation. **03**
(b) Compare Principal Component Analysis and Fisher's Linear Discriminant Analysis. **04**
(c) Consider the following dataset of age and salaries of employees. Apply K-Means clustering algorithm to divide data into TWO clusters. Start with employee E1 as centroid of first cluster and E2 as centroid of the second cluster. Use Euclidean distance. **07**

Employee code	Employee Age	Salary
E1	20	500
E2	40	1000
E3	30	800
E4	18	300
E5	28	1200
E6	25	1400
E7	35	1800

- Q.4** (a) Discuss working of MP (McCullochh Pitts) neuron. **03**
(b) Explain following two activation functions used in neural networks: (1) Sigmoid (2) Tanh **04**
(c) Write and explain Perceptron learning algorithm. **07**

OR

- Q.4** (a) Discuss working of classical Perceptron. **03**
(b) Explain following two activation functions used in neural networks: (1) RELU (2) Softmax **04**
(c) Explain gradient descent algorithm for learning neural network parameters. **07**

- Q.5** (a) Discuss idea of convolution operation with an example. **03**
(b) Discuss various types of non-numeric/notional data. **04**
(c) Explain working of SVM. **07**

OR

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| Q.5 | (a) | Discuss idea of pooling operating used in Convolutional Neural Networks (CNNs) with an example. | 03 |
| | (b) | Explain working of Recurrent Neural Networks (RNN). | 04 |
| | (c) | Explain working of Classification and Regression Trees. | 07 |
