

**B.E. / B.Tech. - DEGREE EXAMINATIONS, NOV / DEC 2025**

Sixth Semester

**Computer Science and Engineering**

**20ITEL806 - PATTERN RECOGNITION TECHNIQUES**

Regulations - 2020

Duration: 3 Hours

Max. Marks: 100

**PART - A (MCQ) (10 × 1 = 10 Marks)**

Answer ALL Questions

	<i>Marks</i>	<i>K- Level</i>	<i>CO</i>
1. In supervised learning, what is the primary requirement for the training data? (a) It must be unlabeled (b) It must be labeled with known outcomes (c) It should have no noise (d) It must contain only numerical data	1	K1	CO1
2. Principal Component Analysis is a method which is best suited for (a) representation of data in low dimensions (b) classification of data (c) clustering of data (d) none of these	1	K1	CO1
3. In the context of pattern recognition, what does clustering refer to? (a) Assigning labels to data based on known outcomes (b) Grouping similar data points together without prior knowledge of labels (c) Identifying outliers in data (d) Assigning a continuous output to data	1	K1	CO2
4. A good clustering method will produce high quality clusters with (a) High inter class similarity (b) Low intra class similarity (c) High intra class similarity (d) No inter class similarity	1	K1	CO2
5. Naive Bayes is considered a: (a) Discriminative model (b) Generative model (c) Non-parametric model (d) Ensemble model	1	K1	CO3
6. In backpropagation, how is the error propagated backward? (a) Through the input layer to the output layer (b) From the output layer to the hidden layers (c) From the output layer to the input layer (d) From the hidden layers to the output layer	1	K1	CO3
7. In the context of class separability, what is meant by the term "between-class variance"? (a) The variance within each class (b) The spread of data points within each class (c) The distance between the means of different classes (d) The variation of data points relative to the center of the data	1	K1	CO4
8. In parametric models, what is typically estimated during the training process? (a) The structure of the model (b) The number of features (c) The model parameters (e.g., mean, variance, weights) (d) The optimal value of k in K-Nearest Neighbors	1	K1	CO4
9. In an HMM, the transition probability matrix represents: (a) The likelihood of observing a particular output given the current state (b) The probability of transitioning from one hidden state to another (c) The probability of starting in a specific state (d) The probability of emitting an observation given a hidden state	1	K1	CO5

10. What is the main difference between fuzzy classification and crisp classification? 1 K1 CO6
- (a) Fuzzy classification uses a binary decision rule, while crisp classification uses a probabilistic rule
- (b) Crisp classification assigns data points to one class, while fuzzy classification allows data points to belong to multiple classes with a degree of membership
- (c) Crisp classification allows for fractional membership, whereas fuzzy classification requires exact membership
- (d) Fuzzy classification is limited to two classes, while crisp classification can handle multiple classes

**PART - B (12 × 2 = 24 Marks)**

Answer ALL Questions

11. List the applications of pattern recognition. 2 K1 CO1
12. Define Bayes theorem. 2 K1 CO1
13. How do you explain the similarity in clustering? 2 K1 CO2
14. Recall the need for Expectation-Maximization algorithm. 2 K1 CO2
15. Outline the procedure for updating centroids in each iteration of K-means clustering. 2 K2 CO3
16. List the purpose of the activation function in backpropagation. 2 K1 CO3
17. State about Receiver Operating Characteristic curve. 2 K1 CO4
18. Compare intraclass variance and interclass variance in the context of class separability. 2 K1 CO4
19. How is a Hidden Markov Model different from a Markov model? 2 K1 CO5
20. Show the purpose of viterbi algorithm. 2 K1 CO5
21. How does the boundary region differ in fuzzy and crisp classification? 2 K1 CO6
22. Define Hebbs rule. 2 K1 CO6

**PART - C (6 × 11 = 66 Marks)**

Answer ALL Questions

23. a) Illustrate the various stages involved in the design of a pattern recognition system. 11 K2 CO1
- OR**
- b) Explain Bayesian Belief Networks with an example. 11 K2 CO1
24. a) Interpret the steps of the EM algorithm with the help of a simple example. 11 K2 CO2
- OR**
- b) Infer the key factors that influence clustering performance in high-dimensional spaces. 11 K2 CO2
25. a) The following data set contains factors that determine whether tennis is played or not. Using Naive Bayes classifier, find the play prediction for the day<Sunny, Cool, High, Strong>. 11 K3 CO3

DAY	OUTLOOK	TEMP	HUMIDITY	WIND	PLAY
Day 1	Sunny	Hot	High	Weak	NO
Day 2	Sunny	Hot	High	Strong	NO
Day 3	Overcast	Hot	High	Weak	YES
Day 4	Rain	Mild	High	Weak	YES
Day 5	Rain	Cool	Normal	Weak	YES
Day 6	Rain	Cool	Normal	Strong	NO
Day 7	Overcast	Cool	Normal	Strong	YES
Day 8	Sunny	Mild	High	Weak	NO
Day 9	Sunny	Cool	Normal	Weak	YES
Day 10	Rain	Mild	Normal	Weak	YES
Day 11	Sunny	Mild	Normal	Strong	YES
Day 12	Overcast	Mild	High	Strong	YES
Day 13	Overcast	Hot	Normal	Weak	YES
Day 14	Rain	Mild	High	Strong	NO

**OR**

- b) Given 7 two dimensional patterns  $A=(2,2)$  ,  $B=(4,4)$ ,  $C=(6,6)$ ,  $D=(0,4)$ ,  $E=(4,0)$ ,  $F=(5,5)$ ,  $G=(9,9)$ . Using K-means algorithm, obtain 3 clusters. *11 K3 CO3*

26. a) Summarize the various types of Preprocessing techniques. *11 K2 CO4*

**OR**

- b) Explain any two feature subset selection methods. *11 K2 CO4*

27. a) Outline Baum-Welch algorithm to learn the parameters of HMM. *11 K2 CO5*

**OR**

- b) Illustrate how support vector machines can be used for classification of following data which are not linearly separable? *11 K2 CO5*

X1	X2	Y
0	0	1
0	1	-1
1	0	-1
1	1	1

28. a) Classify the following data set using Fuzzy C-Means (1,2) (2,4)(3,6) (6,5) (8,4) *11 K2 CO6*  
(Note: no. of classes =2, fuzziness index=2 and criteria convergence=0.001 and no.of iteration=2).

**OR**

- b) Write the training algorithm and testing algorithm of Adaline Network and with a neat architecture. *11 K2 CO6*