Reg. No…….. Name…… **25P352**

M.Sc. DEGREE END SEMESTER EXAMINATION - OCTOBER 2025

SEMESTER – 3: COMPUTER SCIENCE (ARTIFICIAL INTELLIGENCE)

COURSE: 24P3CAIT14EL: PATTERN RECOGNITION

(Regular 2024 Admission)

Time: Three Hours Max. Weights: 30

PART - A

Answer any 8 Questions. **Weight: 1**

1.	Explain the design cycle of a supervised pattern recognition system.	(U, CO1)
2.	Explain the role of feature Extraction.	(U, CO1)
3.	Explain how resampling techniques help in evaluating classifiers.	(U, CO1)
4.	Explain the lack of inherent superiority of any classifier with an example.	(U, CO2)
5.	Explain the role of proximity measures in hierarchical clustering.	(U, CO5)
6.	Explain the difference between partitional and hierarchical clustering.	(U, CO5)
7.	Explain the term “fuzzy inference engine” with an example.	(U, CO2)
8.	Explain why fuzziness is important in modeling real-world problems.	(U, CO2)
9.	Explain how neural networks can be applied in intrusion detection systems.	(U, CO4)
10.	Explain why anomaly detection is considered more general than misuse detection.	(U, CO4)

(1 x 8 = 8)

PART - B

Answer any 6 Questions. **Weights: 2**

11.	Explain Bayes probability formula and derive the decision rule and probability of error for a two category classification with suitable graphs.	(An, CO1)
12.	Apply the k-Nearest Neighbor (k=3) algorithm to classify the test point x = (3,3) using the dataset: Class A: (1,1), (2,2), (2,3) Class B: (6,6), (7,7), (8,8) Show distance calculations and predicted class.	(A, CO2)
13.	Compare CART with Perceptron Algorithm in terms of decision boundaries.	(E, CO2)

14. Explain how clustering can be used for dimensionality reduction with a simple example. (U, CO5)

15. Compute the fuzzy sets A and B defined on the universe X = {1, 3, 4, 5, 7, 9, 11}: (A, CO3)

$$\mu_A(x) = \begin{cases} 0, & x < 2, \\ \dfrac{x-2}{3}, & 2 \le x < 5, \\ 1, & x \ge 5. \end{cases} \qquad \mu_B(x) = \begin{cases} 0, & x < 2, \\ \dfrac{x-2}{2}, & 2 \le x < 4, \\ 1, & 4 \le x < 6, \\ \dfrac{8-x}{2}, & 6 \le x < 8, \\ 0, & x \ge 8. \end{cases}$$

Calculate the union, intersection, complement, bold union, bold intersection

and product of A and B.

16. Explain why feature extraction is important for anomaly-based intrusion detection, with one example feature. (U, CO4)

17. Explain the role of neural networks in intrusion detection with a simple example of input features. (U, CO4)

18. Evaluate why hybrid intrusion detection systems (combining anomaly + misuse) perform better than using one method alone. (E, CO4)

(2 x 6 = 12)

PART - C

Answer any 2 Questions. **Weights: 5**

19. Write a Python program to generate a synthetic dataset consisting of 700 data points, each with 6 features. Apply Fuzzy C-Means clustering to group the data into 10 clusters. You may choose appropriate values for other parameters as needed. Additionally, include a brief explanation of your code. (C, CO5)

20. Consider the following 5 data points in 2D space: (A, CO2)

Points	Coordinates (x,y)
P1	(5,2)
P2	(7,9)

P3	(-5,-3)
P4	(0,-4)
P5	(8,0)

Perform Fuzzy C-Means Clustering (one iterations) and compute the Cluster centres & Updated membership matrix (U) after each iteration with parameters:

Number of clusters = 2, Fuzziness coefficient = 2

Initial membership matrix (U) is given below:

$$U = \begin{bmatrix} 0.3 & 0.2 & 0.9 & 0.5 & 0.8 \\ 0.6 & 0.7 & 0.4 & 0.3 & 0.1 \end{bmatrix}$$

21. Using Principal Component Analysis reduce the given 2D matrix to a 1D matrix (A, CO3)

$$X = \begin{bmatrix} 2 & 1 \\ 3 & 5 \\ 4 & 3 \\ 5 & 6 \end{bmatrix}$$

22. Apply K-means clustering on dataset {(2,2), (4,4), (5,5), (7,8), (9,9), (10,10)} with k=2. Perform 2 iterations and show how centroids shift. Analyze whether initial centroid choice affects the result. (A, CO5)

(5 x 2 = 10)

OBE: Questions to Course Outcome Mapping

CO	Course Outcome Description	CL	Questions	Total Wt.
CO1	Explain and compare a variety of pattern classification, structural pattern recognition, and pattern classifier combination techniques.	An	1,2,3,11	5
CO2	Summarize, analyze, and relate research in the pattern recognition area verbally and in writing.	An	4,7,8,12,13	7
CO3	Apply performance evaluation methods for pattern recognition, and critique comparisons of techniques made in the research literature.	A	15,20,21,22	17

CO4	Apply pattern recognition techniques to real-world problems such as document analysis and recognition.	A	9,10,16,17,18	8
CO5	Implement simple pattern classifiers, classifier combinations, and structural pattern recognizers.	C	5,6,14,19	9

Cognitive Level (CL): Cr - CREATE; E - EVALUATE; An - ANALYZE; A - APPLY; U - UNDERSTAND; R - REMEMBER;