

**Instructions:** All questions are compulsory. Use of non-programmable scientific calculator is allowed.

- Q.1 (a) What is Unsupervised Machine Learning? Explain with its types. (07)  
 (b) What is the difference between Classification and Clustering? (07)

**OR**

- (a) What is clustering? Explain Different types of Clustering? (07)  
 (b) What are some differences between Unsupervised Learning and Reinforcement Learning? (07)

- Q.2 (a) Explain all the ways to choose the right value of K for a K-means clustering. (07)  
 (b) Based on given data points and membership values compute the new cluster centers using the Fuzzy C-Means (FCM) algorithm with  $m = 2$ . (07)

Datapoints (x, y)	Membership values	
	C1	C2
(1, 3)	0.8	0.2
(2, 5)	0.7	0.3
(4, 8)	0.2	0.8
(7, 9)	0.1	0.9

**OR**

- (a) What is Dimension Reduction? What is the Curse of Dimensionality? Explain in detail. (07)  
 (b) Find a Singular Value Decomposition of the Matrix  $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ 1 & 0 \end{bmatrix}$ . (07)

- Q.3 (a) What is the Hierarchical Clustering Algorithm? Explain its types. (07)  
 (b) Using the distance matrix, perform single-link hierarchical clustering. Draw a dendrogram that clearly illustrates the order in which the points are merged. How does the clustering process proceed step by step? (07)

	P1	P2	P3	P4	P5
P1	0	0.10	0.41	0.55	0.35
P2	0.10	0.00	0.64	0.47	0.98
P3	0.41	0.64	0.00	0.44	0.85
P4	0.55	0.47	0.44	0.00	0.76
P5	0.35	0.98	0.85	0.76	0.00

**OR**

- (a) What is the DBSCAN clustering algorithm? How does it work? (07)
- (b) Apply the DBSCAN algorithm to the given data points and create the cluster with minpts= 4 and epsilon = 1.9 (07)

P1 : (3,7)                  P2 : (4.,6)  
 P3 : (5,5)                  P4 : (6,4)  
 P5 : (7,3)                  P6 : (6,2)  
 P7 : (7,2)                  P8 : (8,4)  
 P9 : (3,3)                  P10 : (2,6)  
 P11 : (3,5)                P12 : (2,4)

Use Euclidian distance and calculate the distance between each point.

- Q.4 (a) How do you evaluate the clustering algorithm? (07)
- (b) What is Mean Shift clustering? Explain in detail. (07)

**OR**

- (a) What is PCA? How Principal Component Analysis (PCA) is used for Dimensionality Reduction? (07)
- (b) Give the comparison between DBSCAN with K-Means and Hierarchical Clustering. (07)

- Q.5 Attempt any SEVEN out of TWELVE: (14)
- (1) Mention some real-world applications of unsupervised learning.
- (2) How does unsupervised learning differ from supervised learning?

- (3) What are different distance measures used in clustering?
- (4) How does Fuzzy C-Means differ from K-Means?
- (5) What is PCA (Principal Component Analysis)?
- (6) How does Factor Analysis differ from PCA?
- (7) What are the two types of hierarchical clustering?
- (8) What is the full form of DBSCAN clustering?
- (9) What are the limitations of K-Means clustering?
- (10) What is Curse of Dimensionality?
- (11) What is linkage in hierarchical clustering?
- (12) What are the key steps in Singular Value Decomposition (SVD)?

\*\*\*\*

\*\*\*\*