

**B.E. INFO. TECH. FOURTH YEAR SECOND SEMESTER – 2022**

**Subject: PATTERN RECOGNITION AND APPLICATIONS (HONS.)**

Time : 4hrs

Full Marks: 70

**CO1: Explain the basics of pattern recognition & illustrate related mathematical concepts. (K2,A2). (15 Marks)**

Question 1.

[10+5]

A. Answer any five.

[5\*2]

- i. What is pattern?
- ii. What is a prior probability?
- iii. What do you mean by cluster analysis?
- iv. Define mean and Covariance.
- v. Define the term loss and risk.
- vi. Explain the feature and feature vector with examples.
- vii. What is pattern classification?
- viii. What is unsupervised learning? Explain with an example.

B. Answer any one.

[5\*1]

- i. There are  $n$  bins of which the  $k$ th contains  $k - 1$  blue balls and  $n - k$  red balls. You pick a bin at random and remove two balls at random without replacement. Find the probability that:

- the second ball is red;
- the second ball is red, given that the first is red.

Choose the answer from the option given below. Show how you get the answers.

- (a)  $1/3, 2/3$                       (b)  $1/2, 1/3$                       (c)  $1/2, 2/3$                       (d)  $1/3, 1/3$

- ii. In an experiment,  $n$  coins are tossed, with each one showing up heads with probability  $p$  independently of the others. Each of the coins which shows up heads is then tossed again. What is the probability of observing 5 heads in the second round of tosses, if we toss 15 coins in the first round and  $p=0.4$ ?

(Hint: First find the mass function of the number of heads observed in the second round.)

Choose the answer from the option given below. Show how you get the answers.

- (a) 0.372                      (b) 0.055                      (c) 0.0345                      (d) 0.0488

**CO2 : Demonstrate supervised learning techniques and employ to solve problems. (K3) (15 Marks)**

[5+10]

Question 2. (Answer A and any one from (B and C))

A. Demonstrate how PCA is used for Dimensionality Reduction?

[5]

B. Let  $\omega_{max}(x)$  be the state of nature for which  $P(\omega_{max}|x) \geq (P\omega_i|x)$  for all  $i, i = 1, \dots, c$ .

a) Show that  $P(\omega_{max}|x) \geq \frac{1}{c}$ .

b) Show that for the minimum-error-rate decision rule the average probability of error is given by

$$P(error) = 1 - \int P(\omega_{max}|x) p(x) dx.$$

c) Use these two results to show that by  $P(error) \leq (c - 1)/c$ .

d) Describe a situation for which  $P(error) = \frac{c-1}{c}$ .

[3+3+2+2]

C. What types of *Classification Algorithms* do you know? How do you choose the optimal  $k$  in  $k$ -NN( $k$ -Nearest Neighbours)? What is Cross-Validation and why it is important in supervised learning?

[3+3+4]

**CO 3: Demonstrate unsupervised learning techniques and employ to solve problems. (K3) (15 Marks)**

Question 3. (Answer any one)

A. Answer the following questions.

- Demonstrate algorithmic steps of K-means algorithms.
- What assumptions are used for K-means?
- To which category of clustering schemes does the k-means algorithm belong?
- What are the factors that influence the computational duration of this algorithms?
- What is K in K-means algorithms and what is its significance?
- What are the variants of K-means?

[5+2+1+2+3+2]

B. Answer the following questions.

- What is Density-based Clustering?
- Demonstrate the algorithmic steps involved in order to develop DBSCAN clustering algorithms.
- How does the epsilon value effects the DBSCAN clustering algorithms?
- List out the advantages and disadvantages of DBSCAN Algorithm.
- Why does there arise a need for DBSCAN when we already have other clustering Algorithms?

[2+5+3+3+2]

**CO 4: Differentiate and illustrate different feature selection methods. (K4) (5 Marks)**

Question 4. (Answer any one)

A. Answer the following:

- What is the difference between filter and wrapper evaluation methods?
- Can we use PCA for feature selection? Explain.

[2+3]

B. Answer the following:

- What's the difference between *Forward* and *Backward Feature Selection*?
- What is fitness function? Why it is important?

[2+3]

**CO 5: Explain and illustrate brief idea on Evolutionary computing. (K2) (10 Marks)**

Question 5. Write short notes on any two:

- Evaluation Function
- Mutation
- Recombination

**CO6: Study different advance techniques & employ them in different domains to solve the problems(K3) (10 Marks)**

Question 6. (Answer any one)

A. Explain artificial neural networks and its parameter optimization techniques.

B. Describe the working principle of Back-propagation learning algorithm in artificial neural networks.