

**N.B. :** (1) Question No. 1 is compulsory.

(2) Attempt any three questions out of remaining five questions

Q.1. (a) Find the Eigen values and Eigen vectors of  $A = \begin{bmatrix} -5 & 2 \\ -7 & 4 \end{bmatrix}$  (5)

(b) A random variable X has following probability distribution (5)

X	0	1	2	3	4	5	6
P(X=x)	K	3K	5K	7K	9K	11K	13K

Find (i) Value of K and Mean of X

(ii) Find Cumulative Distribution function of X

(c) Compare discrete and continuous data. (5)

(d) Obtain the Hessian Matrix for the function (5)

$$Z = x_1x_2 + 9x_1 + 6x_3 - x_1^2 - x_2^2 - x_3^2$$

Q.2. (a) Find Singular Value of Decomposition of matrix  $A = \begin{bmatrix} 1 & 1 \\ 0 & 1 \\ -1 & 1 \end{bmatrix}$  (10)

(b) Two samples of sizes 9 and 8 give the sum of squares of deviations from their respective means as 160 inches square and 91 inches square respectively. Test the hypothesis that the variances of the two populations from which the samples are drawn are equal at 10% level of significance. (10)  
(Given  $f_{((8,7),0.05)}=3.73$  ,  $f_{((8,7),0.95)}=0.286$  )

Q.3. (a) The following table gives the random sample of marks obtained by students in two schools, A and B (10)

School A	63	72	80	60	85	83	70	72	81
School B	86	93	64	82	81	75	86	63	63

Is the variance of Marks of the students in School A is less than that of those in School B? Test at 5% level of significance.

(Given  $F_{((8,8),0.95)}=0.291$  )

(b) Explain types of data. Compare and contrast quantitative and qualitative data. (10)

Q.4. (a) What is a Graph? Explain any four types of Graph along with its uses. (10)

(b) Describe with example and action to be taken for the following (10)

- Data cleaning
- Irrelevant data
- Incorrect data
- Handle Missing Data
- Outliers

Q.5. (a) Minimize the function  $f(x_1, x_2) = 4x_1 + 8x_2 - x_1^2 - x_2^2$  (10)  
subject to  $x_1 + x_2 = 4$ ,  $x_1, x_2 \geq 0$

(b) Find the minimizer of  $f(x) = x^2 + \frac{54}{x}$  using bisection method in (2,5) (10)  
within a range of 0.3

- Q.6. Write short notes on (any four) (20)
- (a) Four Fundamental Subspaces. (5)
  - (b) Linear Discriminant Analysis technique. (5)
  - (c) Principal Component Analysis (PCA) algorithm. (5)
  - (d) Machine learning Models. (5)
  - (e) Non gradient based optimization technique. (5)
  - (f) Time series graph. (5)
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