(3 Hours) **Total Marks: 80**

N.B. : **(1)** Question No. 1 is compulsory.
(2) Attempt any three questions out of remaining five questions

Q.1 (a) By using matrices, solve the following system of linear equation **(5)**
$20x + y - 2z = 17,\ 3x + 20y - z = -18,\ 2x - 3y + 20z = 25.$

(b) State Central limit theorem. Let $\bar{X}$ be the mean of a random sample of size 50 drawn from a population with mean 112 and standard deviation 40. **(5)**
a. Find the mean and standard deviation of $\bar{X}$.
b. Find the probability that $\bar{X}$ assumes a value between 110 and 114.

(c) Obtain the graph of $y = e^{-2x}$ **(5)**

(d) Compare constrained and non-constrained optimization Techniques. **(5)**

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

(b) Ten students were given intensive coaching for a month in Statistics. The scores obtained in tests are given below. **(10)**

Sr. No	1	2	3	4	5	6	7	8	9	10
Marks in 1st test	50	52	53	60	65	67	48	69	72	80
Marks in 2nd test	65	55	65	65	60	67	49	82	74	86

Does the score from test 1 to test 2 show an improvement? Test at 5% level of significance.

Q.3. (a) Out of 800 persons 25% were literate and 300 had travelled beyond the limits of the district. 40% of the literates were among those who had not travelled. Prepare a 2 x 2 table and test at 5% level of significance whether there is any relation between travelling and literacy. **(10)**

(b) Draw two Pie diagrams to represent the following data giving profits of different partners in a firm. **(10)**

Partner	Profit (in ₹) 2021	Profit (in ₹) 2022
A	2200	1400
B	2000	1600
C	1800	2900
D	1600	1700
E	1400	1600
F	1000	800
Total	**10, 000**	**10,000**

Q.4. (a) Find 3 yearly moving averages and represent these on a graph paper. Also represent the original time series on the graph. **(10)**

Year	1999	2000	2001	2002	2003	2004	2005	2006	2007
Sales (in lakhs)	12	15	20	18	25	32	30	40	44

(b) Minimize the function $f(x_1, x_2) = 4x_1 + 8x_2 - x_1^2 - x_2^2$ **(10)**
subject to $x_1 + x_2 = 4,\quad x_1, x_2 \geq 0$

Q.5. (a) Explain the need for exploratory data analysis. Also list and explain exploratory data analysis techniques. **(10)**

(b) Find the root of the equation $x^3 - 4x - 9 = 0$ using bisection method correct three decimal places in the interval (2, 3). **(10)**

Q.6. (a) Describe with example and action to be taken for the following **(10)**

1. Data Cleaning
2. Irrelevant data
3. Incorrect data
4. Data cleaning
5. Outliers

(b) Write a short note on linear discriminant analysis techniques and principal component analysis algorithm **(10)**
