(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 x-y+z=0, x+2y+z=0, 2x+y+3z=0 **(5)**

(b) Differentiate between Simple Random Sampling and Non random Sampling **(5)**

(c) Obtain the Graph of y=log(2x). **(5)**

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

Q.2. (a) Find Singular Value of Decomposition of matrix $A = \begin{bmatrix} 2 & 3 & 2 \\ 2 & 3 & -2 \end{bmatrix}$ **(10)**

(b) A school Principal claims that students in his school are above average intelligence. A random survey of thirty students shows mean IQ score of 112.5 Is there sufficient evidence to support principals claim if the mean of population IQ is 100 with standard deviation 15. Test at 5% level of significance. (Given z=1.645 at 5% L.O.S. for right tailed test) **(10)**

Q.3. (a) A survey was conducted with 500 female students of which 60% were intelligent, 40% had uneducated fathers, while 30 % of the not intelligent female students had educated fathers. Test the hypothesis that the education of fathers and intelligence of female students are independent at 5% level of significance. (Given $\chi^2(1,0.05) = 3.841$) **(10)**

(b) What is a scatter plot and explain types of correlation in scatter plot with example **(10)**

Q.4. (a) Explain types of data. Compare discrete and continuous data **(10)**

(b) Discuss the need for exploratory data analysis and explain EDA techniques **(10)**

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

(b) Minimize the function $f(x_1, x_2) = 8x_1 + 10x_2 + 6x_3 + 2x_1^2 + x_2^2 + 3x_3^2$ subject to $x_1 + x_2 + x_3 = 20, \quad x_1, x_2, x_3 \geq 0$ **(10)**

Q.6. Write short notes on (any four) **(20)**

(a) Four Fundamental Subspaces **(5)**

(b) Linear discriminant analysis. **(5)**

(c) non-linear dimensionality reduction-Isomap **(5)**

(d) Feature engineering **(5)**

(e) Gradient based optimization Techniques **(5)**

(f) Stem and leaf plot **(5)**
