CBCS SCHEME

USN [| | | | | | | | |]

Fourth Semester B.E./B.Tech. Degree Examination, Dec.2025/Jan.2026
Engineering Statistics and Linear Algebra

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Given the data in the following table:

K	1	2	3	4	5
X_K	2.1	3.2	4.8	5.4	6.9
$P(X_K)$	0.21	0.18	0.20	0.22	0.19

(i) Plot the PDF and CDF of discrete random variable.

(ii) Write the expression of PDF and CDF using unit delta and unit step functions. **(08 Marks)**

b. The following is the PDF for random variable U

$f_u(u) = Ce^{-u/3}$ for $u > 0$.

$= 0$ otherwise

Find the value of C and evaluate $F_u(0.5)$ **(08 Marks)**

c. Mention the properties of PDF. **(04 Marks)**

OR

2 a. Define Binomial Random Variable. Obtain the characteristic function of a binomial random variable and hence find the mean and variance using the characteristic function. **(10 Marks)**

b. A PDF is described by $C(z-4)$ for all values of z between 6 and 10 and is 0 otherwise. Find the value of C and evaluate $P(z > 9)$. **(10 Marks)**

Module-2

3 a. The Joint PDF $f_{XY}(x, y) = C$, a constant when $(0 < x < 2)$ and $(0 < y < 3)$ and is 0 otherwise.

i) What is the value of constant C?
ii) What is the Pdfs of X and Y?
iii) What is $F_{XY}(x, y)$?
iv) What are $F_{XY}(x, \alpha)$ and $F_{XY}(\alpha, y)$?
v) Are X and Y independent? **(10 Marks)**

b. Define Correlation Coefficient of random variables X and Y. Show that its bounded by limits ± 1. **(10 Marks)**

OR

4 a. A bivariate Pdf

$f_{XY}(x, y) = 0.2\delta(x)\,\delta(y) + 0.3\delta(x-1)\,\delta(y) + 0.3\delta(x)\,\delta(y-1) + C\delta(x-1)\,\delta(y-1)$

for two discrete random variables.

i) Find C
ii) What are the Pdfs of X and Y?
iii) What is $F_{XY}(x, y)$ when $0 < x < 1$ and $0 < y < 1$?
iv) What are $F_{XY}(X, \alpha)$ and $F_{XY}(\alpha, Y)$
v) Are X and Y independent? **(10 Marks)**

b. Briefly explain the following random variables :
i) Chi-square Random Variable
ii) Students Random Variable **(10 Marks)**

Module-3

5 a. With the help of an example, define Random Process and discuss distributions and density functions of a Random Process. **(06 Marks)**

b. Let the two random process X(t) and Y(t) be given as

$X(t) = A\cos w_c t + B\sin w_c t$

$Y(t) = B\cos w_c t - A\sin w_c t$

'A' and 'B' are uncorrelated, zero mean random variables with same variance. Obtain the cross correlation of X(t) and Y(t) and show that the two processes are jointly wide sense stationary. **(10 Marks)**

c. List the properties of Cross-Correlation function. **(04 Marks)**

OR

6 a. A random process is described by $X(t) = A\cos(w_c t + \theta)$ where A and w_c are constants and 'θ' is a Random variable distributed uniformly between $-\pi$ to π. Is X(t) wide sense stationary? If so, then compute the mean and the auto correlation function for the random process. **(10 Marks)**

b. Define Autocorrelation Function of a random process and discuss its properties. **(10 Marks)**

Module-4

7 a. Do the following vectors form orthogonal and orthonormal basis vectors.

$$u = \begin{bmatrix} 1 \\ 0 \\ -1 \end{bmatrix};\quad v = \begin{bmatrix} 1 \\ \sqrt{2} \\ 1 \end{bmatrix};\quad w = \begin{bmatrix} 1 \\ -\sqrt{2} \\ 1 \end{bmatrix}$$ **(08 Marks)**

b. Apply Gram Schmidt process to orthonormalize the following vectors.

$$v_1 = \begin{bmatrix} 1 \\ -1 \\ 1 \end{bmatrix};\quad v_2 = \begin{bmatrix} 1 \\ 0 \\ 1 \end{bmatrix};\quad v_3 = \begin{bmatrix} 1 \\ 1 \\ 2 \end{bmatrix}$$ **(12 Marks)**

OR

8 a. Let $I : V \rightarrow R$ be the integral mapping

$$I(V) = \int_0^1 V(t)\,dt$$

Show that I is a linear transformation. **(08 Marks)**

b. Compute the dimension, Rank and Basis for the four fundamental sub space for the given matrix $A = \begin{bmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 7 \\ -1 & -3 & 3 & 4 \end{bmatrix}$ **(12 Marks)**

Module-5

9 a. If a 4 × 4 matrix has $\det(A) = 1/2$, find:
i) det (2A) ii) det (-A) iii) det (A^2) iv) det (A^{-1}) **(08 Marks)**

b. For the given matrix $A = \begin{bmatrix} 1 & 1 \\ -2 & 4 \end{bmatrix}$

i) Check if the matrix is a positive definite matrix.

ii) Compute eigen values and eigen vectors for the matrix

iii) Is the matrix diagonalizable? **(12 Marks)**

OR

10 a. By applying row operation to produce an upper triangular matrix U, compute det(A) and det(B)

$$A = \begin{bmatrix} 1 & 2 & -2 & 0 \\ 2 & 3 & -4 & 1 \\ -1 & -2 & 0 & 2 \\ 0 & 2 & 5 & 3 \end{bmatrix}$$

$$B = \begin{bmatrix} 2 & -1 & 0 & 0 \\ -1 & 2 & -1 & 0 \\ 0 & -1 & 2 & -1 \\ 0 & 0 & -1 & -2 \end{bmatrix}$$

(08 Marks)

b. Construct Singular Value Decomposition (SVD) for the given matrix

$$A = \begin{bmatrix} 4 & 11 & 14 \\ 8 & 7 & -2 \end{bmatrix}$$

(12 Marks)

* * * * *