CBCS SCHEME

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Fourth Semester B.E. Degree Examination, Dec.2024/Jan.2025
Engineering Statistics and Linear Algebra

Time: 3 hrs. Max. Marks: 100

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

Module-1

1 a. Define CDF of a Random variable. Mention its properties and types. **(10 Marks)**

b. Given the data in the Table Q1(b)
i) Plot the PDF and CDF of the discrete random variable
ii) Write expressions for $f_X(x)$ and $F_X(x)$ using unit delta functions and unit step functions :

x	x_a	x_b	x_c	Total
P[X = x]	0.24	0.32	0.44	1

Table Q1(b) **(10 Marks)**

OR

2 a. Summarize the properties of PDF. Prove that the total area under PDF curve is unity. **(10 Marks)**

b. Given the data in the Table Q2(b).
i) What are the mean and variance of 'X' ii) If $Y = X^2 + 2$, what are μ_y and σ_y^2.

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	0.2	0.22	0.19

Table Q2(b) **(10 Marks)**

Module-2

3 a. Explain the following with respect to Bivariate Random variable.
i) Correlation ii) Covariance iii) Uncorrelated X and Y iv) Orthogonal X and Y v) Independent X and Y. **(10 Marks)**

b. Let X is a random variable, $\mu_x = 4$ and $\sigma_x = 5$ and Y is a random variable, $\mu_y = 6$ and $\sigma_y = 7$. The correlation coefficient is -0.7. If U = 3x + 2y, what are i) Var [U] ii) CoV [UX] iii) CoV [UY]. **(10 Marks)**

OR

4 a. Briefly explain the following random variables
i) Chi-square RV ii) Student-T RV iii) Cauchy RV iv) Rayleigh RV. **(10 Marks)**

b. The joint PDF $f_{XY}(x, y) = C$, a constant when $(0 < x < 3)$ and $(0 < y < 3)$ and is '0' otherwise.
i) What is the value of constant C
ii) What is the PDF's for X and Y
iii) What is $F_{XY}(x, y)$ when $(0 < x < 3)$ and $(0 < y < 3)$
iv) What are $F_{XY}(x, \infty)$ and $F_{XY}(\infty, y)$
v) Are X and Y independent? **(10 Marks)**

Module-3

5 a. Interpret the following with respect to random process i) Random process ii) Ensemble iii) PDF iv) Independence v) Expectations vi) Stationary. **(12 Marks)**

b. The magnitude of a zero mean white noise spectrum is $K = 3.6 \times 10^{-8}$ V^2-S. This noise is the input to a low pass RC circuit: R = 38 kΩ, C = 0.1 μF. Find the networks output PSD, $S_y(w)$. **(08 Marks)**

OR

6 a. Discuss the Auto correlation and cross correlation functions with their properties. **(12 Marks)**

b. A Random process is described by $y(t) = A\cos(w_c t + \theta)$ where A and w_c are constants, but θ is a random variable distributed uniformly between $\pm\pi$. Determine :
i) PDF of random variable 'θ'
ii) Mean of y(t)
iii) Auto correlation function $R_y(\tau)$
iv) Mean power and Auto variance of y(t) **(08 Marks)**

Module-4

7 a. Illustrate vector space with its properties in detail. **(08 Marks)**

b. Apply Gram-Schmidt process to

$$a = \begin{bmatrix} 0 \\ 0 \\ 1 \end{bmatrix} \quad b = \begin{bmatrix} 0 \\ 1 \\ 1 \end{bmatrix} \text{ and } c = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix}$$

Write the result in the form of A = QR. **(12 Marks)**

OR

8 a. Outline the four fundamental suspaces of matrices. **(08 Marks)**

b. Determine : i) matrix U and Rank ii) rref (R) iii) Null space of matrix and identify free variables in null space for the matrix given $A = \begin{bmatrix} 1 & 3 & 3 & 2 \\ 2 & 6 & 9 & 7 \\ -1 & -3 & 3 & 4 \end{bmatrix}$ **(12 Marks)**

Module-5

9 a. Define determinants with its properties in detail. **(13 Marks)**

b. Determine the Eigen values of matrix $A = \begin{bmatrix} 2 & 2 & 1 \\ 1 & 3 & 1 \\ 1 & 2 & 2 \end{bmatrix}$ **(07 Marks)**

OR

10 a. Diagnolize the matrix $A = \begin{bmatrix} 1 & 6 & 1 \\ 1 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}$ and hence find A^4, Also find the matrix 'P' such that $P^{-1}AP$ is diagonal. **(14 Marks)**

b. Reduce the matrix A to U and find det A using pivots of A.

$$A = \begin{bmatrix} 2 & 5 & 3 \\ 1 & 2 & 4 \\ -1 & 3 & 6 \end{bmatrix}$$ **(06 Marks)**

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