VIT

Vellore Institute of Technology

(Deemed to be University under section 3 of UGC Act, 1956)

School of Electronics Engineering
Winter Semester (2019-20)
CAT 1

Slot: B1 | Duration: 90 minutes

Course Code: ECE2005 | Max Marks: 50

Course Name: Probability Theory and Random Process

Instructions: Answer **all** questions. Each question carries **ten** marks

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1. The power (in milliwatts) returned to a radar from a certain class of aircraft has the probability density function

$$f_P(p) = \frac{1}{10} e^{-\frac{p}{10}} u(p)$$

Suppose a given aircraft belongs to this class but is known to not produce a power larger than 15mW.

   (a) Find the probability density function of P conditional on $P \leq 15mW$.

   (b) Find the conditional mean value of P

2. The joint pdf of a bivariate random variable (X,Y) is given by

$$f_{XY}(x,y) = \begin{cases} k & 0 < y \leq x < 2 \\ 0 & \text{otherwise} \end{cases}$$

Where k is constant

   (a) Determine the value of k

   (b) Find the Marginal pdf's of X and Y

   (c) Find $P\left(0 < X < 1/2, 0 < Y < 1/2\right)$

3. Let X_k be three independent identically distributed random variables uniformly distributed over $[-0.5, 0.5]$. Compute and plot the PDF of $Y = \sum_{k=1}^{3} X_k$. Compare the result with the PDF of corresponding Gaussian random variable.

Please turn over...

4. A complex random variable $Z = X + jY^2$, where X and Y are independent real random variables uniformly distributed between $-\pi$ and π. Find the mean and variance of Z

5. Two Gaussian random variable X_1 and X_2 are defined by the mean and covariance matrices as

$$[\bar{X}] = \begin{bmatrix} 0.5 \\ 3 \end{bmatrix}$$

$$[C_X] = \begin{bmatrix} 4 & 2 \\ 2 & 3 \end{bmatrix}$$

Two random variables Y_1 and Y_2 are formed using transformation .

$$[T] = \begin{bmatrix} 2 & 1 \\ 3 & 2 \end{bmatrix}$$

Find C_Y and $\bar{Y}$ and $f_{Y_1,Y_2}(y_1, y_2)$