VIT
Vellore Institute of Technology

**School of Electronics Engineering**
**Winter Semester (2023-2024)**
**Continuous assessment test - I**
**BECE207L – Random Processes**

**Date: 15-FEB-2024** **SLOT: E1+TE1** **Marks: 50**
**Duration: 90 Min**

| Q. No | Answer All Questions | Marks | CO | BL |
|---|---|---|---|---|
| 1. | The joint probability distribution function of two random variables X and Y is<br>$F_{X,Y}(x,y) = (1-e^{-2x})(1-e^{-3y})\,; \quad x \geq 0 \text{ and } y \geq 0$<br>Find the marginal distributions $F_X(x)$ and $F_Y(y)$. Also, determine the joint probability density function $f_{X,Y}(x,y)$. | 10 | CO1 | L3 |
| 2. | (a) A navigation of a target is defined by a random variable X (in kilometers) which follows Weibull distribution defined by<br>$F_X(x) = \left[1-e^{\frac{-x^3}{2}}\right]u(x)$ with the navigation error of 1.5km.<br>Find the conditional density $f_X(x/(X \leq 1.2km))$<br>(b) Random variables X and Y have respective density functions as<br>$f_X(x) = 0.1\delta(x) + 0.2\delta(x-1) + 0.4\delta(x-2) + 0.3\delta(x-3)$<br>$f_Y(y) = 0.4\delta(y-1) + 0.5\delta(y-2) + 0.1\delta(y-3)$<br>Find the density function of $W = X + Y$ if $X$ and $Y$ are independent. | 10 | CO1 | L3 |
| 3. | If U and V are the complex random given as $U = X + jY$ and $V = X - jY$ , find the mean, variance and covariance of the random variables U and V. | 10 | CO2 | L3 |
| 4. | A joint density is given as<br>$f_{X,Y}(x,y) = c\{x(y+1.5)\}\ 0 < x < 1 \text{ and } 0 < y < 1$<br>Find the value of c for the above function to be valid pdf . Also compute all the joint moments $m_{nk}$, $n$ and $k = 0,1$. | 10 | CO2 | L3 |
| 5. | Consider two Gaussian random variables $X_1$ and $X_2$ with var($X_1$) = 5, var($X_2$) =10, and $C_{X1,X2}$ = -1, that are transformed into two new random variables $Y_1$ and $Y_2$ through coordinate rotation by an angle of 45°. Determine the covariance matrix and hence the correlation coefficient of the transformed random variables $Y_1$ and $Y_2$.<br>Hint: Coordinate rotation is given by the following transformation.<br>$Y_1 = (cos\theta)X_1 + (sin\theta)X_2$ and<br>$Y_2 = (-sin\theta)X_1 + (cos\theta)X_2$ | 10 | CO2 | L3 |