Dhirubhai Ambani Institute of Information and Communication Technology (DA-IICT)
First In Semester Examination
CT314 (Statistical Communication Theory)
Date of Examination: Feb 07, 2018
Duration: 2 Hours
Maximum Marks: 20

Instructions: 1. Attempt all questions. 2 Use of scientific non programmable calculator is permitted. 3. All the acronyms carry their usual meaning.

Q1 Write the sample space corresponding to the following experiments. (4 marks)

a. Determine the values of voltage waveform at time t_1 .
b. Pick a number X at random between zero and one, then pick a number Y at random between zero and X.
c. Select a ball from an urn containing balls numbered 1 to 4. Suppose that balls 1 and 2 are black and 3 and 4 are white. Note the number and color of ball you select.
d. Toss the coin 3 times and note the number of tails.

Q2: Show that if A_1, A_2, A_3 are independent then A_1 is independent of $A_2 + A_3$ (2 marks)

Q3: Define random variable. What is the condition for its existence? (2 marks)

Q4: Samples are drawn from Gaussian distributed random variable X having zero mean and variance 1 (As you have done in your lab). We now want to obtain the sample values from these drawn samples so that they represent Gaussian random variable Y with mean 2 and variance 4. Write the transformation to be performed on X to get Y i.e., write the function g(X). Give (approximate) plots of the PDFs of X and Y. Write the mathematical expressions for these PDFs. (5 marks)

Q5: Let S be a sample space with six sample points. The events identified on S are $A = \{s_1, s_2\}$, $B = \{s_3, s_4, s_5\}$ and $C = \{s_6\}$ with $P(A) = \frac{1}{3}$, $P(B) = \frac{1}{2}$, $P(C) = \frac{1}{6}$. Let $X(\,)$ be the transformation given by $X(s_i) = 10, \quad i = 1, 2$, $X(s_i) = 20, \quad i = 3, 4, 5$ and $X(s_i) = 30, \quad i = 6$. Plot the CDF and PDF of X. (3 marks)

Q6: Consider the half wave rectifier transformation $Y = g(X)$ which is given as: $Y = 0, \ for \ X \le 0$ and $Y = X, \ for \ X > 0$. If X has uniform PDF in the range -0.5 to 1.5, plot the CDF and PDF for X as well for Y. Note that Y is a constant (equal to zero) in the range $(-\infty, 0)$. Hence, there exists discontinuity at $y = 0$ for $F_Y(y)$ that leads to an impulse for $f_Y(y)$. (4 marks)