Code No: 07A3EC10 **Set No. 1**

II B.Tech I Semester Regular Examinations, November 2008
PROBABILITY THEORY AND STOCHASTIC PROCESSES
(Common to Electronics & Communication Engineering, Electronics & Telematics and Electronics & Computer Engineering)

Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Discuss Joint and conditional probability.
   (b) When are two events said to be mutually exclusive? Explain with an example.
   (c) Determine the probability of the card being either red or a king when one card is drawn from a regular deck of 52 cards. [6+6+4]

2. (a) Define Random variable and give the concept of random variable.
   (b) In an experiment of rolling a die and flipping a coin. The random variable(X) is chosen such that:
      i. A coin head (H) outcome corresponds to positive values of X that are equal to the numbers that show upon the die and
      ii. A coin tail (T) outcome corresponds to negative values of X that are equal in magnitude to twice the number that shows on die. Map the elements of random variable X into points on the real line and explain.
   (c) In experiment where the pointer on a wheel of chance is spun. The possible outcomes are the numbers from 0 to 12 marked on the wheel. The sample space consists of the numbers in the set $\{0 < \mathrm{S} < = 12\}$ and if the random variable X is defined as $\mathrm{X} = \mathrm{X(S)} = \mathrm{S}^2$, map the elements of random variable on the real line and explain. [4+6+6]

3. (a) State and prove properties of variance of a random variable.
   (b) Let X be a random variable defined by the density function
   $$\begin{aligned} f_X(x) &= (\pi/16)\cos(\pi x/8), \quad -4 \le x \le 4 \\ &= 0, \qquad \textit{elsewhere} \end{aligned}$$
   Find E [3X] and E[X^2]. [8+8]

4. (a) Find the density function of W = X + Y where the densities of X and Y are assumed to be
   $f_X(x) = \frac{1}{a}[u(x) - u(x-a)]$
   $f_Y(y) = \frac{1}{b}[u(y) - u(y-b)]$
   Where 0 < a < b.
   (b) Given the function
   $G(x, y) = u(x)\,u(y)\left[1 - e^{-(x+y)}\right]$
   Show that this function satisfies the first four properties of joint probability distribution function but fails the fifth one. The function is therefore not a valid joint probability distribution function. [8+8]

5. (a) Write the expression for expected value of a function of random variables and prove that the mean value of a weighted sum of random variables equals the weighted sum of mean values.
   (b) X is a random variable with mean $\bar{X} = 3$, variance $\sigma_X^2 = 2$.
      i. Determine the second moment of X about origin
      ii. Determine the mean of random variable y = where y = -6X +22. [8+8]

6. Discuss in detail about:
   (a) First order stationary random process
   (b) Second order & Wide - Sense Stationary Random Process. [8+8]

7. (a) A WSS random process X(t) has $R_{XX}(\tau) = A_0\left[1 - \frac{|\tau|}{\tau}\right] \quad -\tau \le t \le \tau$
   $= 0 \quad$ else where
   Find power density spectrum.
   (b) $R_{XX}(\tau) = \frac{A_0^2}{2}\sin\omega_0\tau$. Find $S_{xx}(\omega)$ [8+8]

8. (a) What are the precautions to be taken in cascading stages of a network from the point of view of noise reduction?
   (b) What is the need for band limiting the signal towards the direction of increasing SVR? [8+8]

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Code No: 07A3EC10 **Set No. 2**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks
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1. (a) Is probability relative frequency of occurrence of some event? Explain with an example.
   (b) One card is drawn from a regular deck of 52 cards. What is the probability of the card being either red or a king? [8+8]

2. (a) Define Random variable and give the concept of random variable.
   (b) In an experiment of rolling a die and flipping a coin. The random variable(X) is chosen such that:
      i. A coin head (H) outcome corresponds to positive values of X that are equal to the numbers that show upon the die and
      ii. A coin tail (T) outcome corresponds to negative values of X that are equal in magnitude to twice the number that shows on die. Map the elements of random variable X into points on the real line and explain.
   (c) In experiment where the pointer on a wheel of chance is spun. The possible outcomes are the numbers from 0 to 12 marked on the wheel. The sample space consists of the numbers in the set $\{0 < S <= 12\}$ and if the random variable X is defined as $X = X(S) = S^2$, map the elements of random variable on the real line and explain. [4+6+6]

3. (a) In an experiment when two dice are thrown simultaneously, find expected value of the sum of number of points on them.
   (b) The exponential density function given by
   $$f_x(x) = (1/b)e^{-(x-a)/b} \quad x > a$$
   $$= 0 \quad x < a$$
   Find out variance and coefficient of skewness. [6+10]

4. (a) Consider a probability space S = (Ω, F, P). Let $\Omega = \{\xi 1....\xi 5\}$ = {-1, -1/2, 0, 1/2, 1} with $P\xi_i = 1/5$ i = 1..5. Define two random variables on S as follows: $X(\xi) = \xi$ and $Y(\xi) = \xi^2$
      i. Show that X and Y are dependent random variables
      ii. Show that X and Y are uncorrelated.
   (b) Let X and Y be independent random variables each N (0, 1). Find the mean and variance of $Z = (X^2+Y^2)^{1/2}$. [8+8]

5. (a) Write the expression for expected value of a function of random variables and prove that the mean value of a weighted sum of random variables equals the weighted sum of mean values.

   (b) X is a random variable with mean $\bar{X} = 3$, variance $\sigma_X^2 = 2$.

      i. Determine the second moment of X about origin

      ii. Determine the mean of random variable y = where y = -6X +22. [8+8]

6. (a) Given X(t) = A cos ω_0t + B sin ω_0t where A & B are R.V's & ω_0 is a const. S.T X(t) is Wss if A & B are uncorrelated zero mean R.V's having different density functions but the same variancess σ^2.

   (b) State the properties of cross correlation. [8+8]

7. (a) For X(t) and Y(t) are random process and prove that $S_{XX}(\omega) = \lim_{t\to\infty} \frac{E\left[X_T^*(\omega)Y_T(\omega)\right]}{2T}$

   (b) $R_{XY}(\tau) = 4u(\tau)\,e^{-\alpha\tau}$. Find $S_{XY}(\omega)$ [12+4]

8. (a) Explain how the available noise power in an electronic circuit can be estimated.

   (b) What are the different noise sources that may be present in an electron devices? [8+8]

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Code No: 07A3EC10 **Set No. 3**

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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
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1. (a) What is sample space? Explain the Discrete sample space and Continuous sample space with suitable example each.
   (b) In a game of dice a "shooter" can win outright if the sum of the two numbers showing up is either 7 or 11 when two dice are thrown. What is his probability of winning outright? [8+8]

2. (a) What are point conditioning and interval conditioning distribution function? Explain.
   (b) If P(x) = 0.1x, x = 1,2,3,4
   = 0, otherwise
   Find:
      i. P{X = 1 or 2}
      ii. P{(1/2) < X (5/2)X > 1}. [8+8]

3. (a) If the random variable X has the moment generating function $M_X(t) = \frac{2}{2-t}$, determine the variance of X.
   (b) Show that the distribution function for which the characteristic function $e^{-|t|}$ has the density:
   $f_X(x) = \frac{1}{\pi(1+x^2)}, -\infty < x < \infty$
   (c) Explain the nonmonotonic transformation of a random variable. [6+6+4]

4. (a) Define and explain conditional probability mass function. Give its properties.
   (b) The joint probability density function of two random variables X and Y is given by $\begin{aligned} \mathrm{f(x, y)} &= \mathrm{C(2x + y)}, \quad 0 \le \mathrm{x} \le 1, 0 \le \mathrm{y} \le 2 \\ &= 0, \qquad\qquad elsewhere \end{aligned}$
   Find:
      i. the value of 'C'
      ii. Marginal distribution functions of X and Y. [8+8]

5. (a) Write the expression for expected value of a function of random variables and prove that the mean value of a weighted sum of random variables equals the weighted sum of mean values.
   (b) X is a random variable with mean $\bar{X} = 3$, variance $\sigma_X^2 = 2$.
      i. Determine the second moment of X about origin

ii. Determine the mean of random variable y = where y = -6X +22. [8+8]

6. Discuss in detail about:
   (a) First order stationary random process
   (b) Second order & Wide - Sense Stationary Random Process. [8+8]

7. The auto correlation function of a random process X(t) is $R_{XX}(\tau) = 3+2\exp(-4\tau^2)$.
   (a) Find the power spectrum of X(t).
   (b) What is the average power in X(t)
   (c) What fractional power lies in the frequency band $\frac{-1}{\sqrt{2}} \leq \omega \leq \frac{1}{\sqrt{2}}$. [6+4+6]

8. (a) What are the precautions to be taken in cascading stages of a network from the point of view of noise reduction?
   (b) What is the need for band limiting the signal towards the direction of increasing SVR? [8+8]

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Code No: 07A3EC10

Set No. 4

II B.Tech I Semester Regular Examinations, November 2008
PROBABILITY THEORY AND STOCHASTIC PROCESSES
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Time: 3 hours **Max Marks: 80**

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Explain the terms Joint probability and Conditional probability.
   (b) Show that Conditional probability satisfies the three axioms of probability.
   (c) Two cards are drawn from a 52-card deck (the first is not replaced):
      i. Given the first card is a queen. What is the probability that the second is also a queen?
      ii. Repeat part (i) for the first card a queen and second card a 7.
      iii. What is the probability that both cards will be the queen? [4+6+6]

2. (a) Define cumulative probability distribution function. Discuss distribution function specific properties.
   (b) The random variable X has the discrete variable in the set {-1,-0.5, 0.7, 1.5, 3} the corresponding probabilities are assumed to be {0.1, 0.2, 0.1, 0.4, 0.2}. Plot its distribution function and state is it a discrete or continuous distribution function. [8+8]

3. (a) A random variable X is uniformly distributed in the interval (-5 , 15). Another random variable Y = $e^{-x/5}$ is formed. Find E[Y] and f_Y(y).
   (b) Explain the following terms:
      i. Conditional Expected value
      ii. Covariance.
   (c) Find the Expected value of the number on a die when thrown. [8+6+2]

4. (a) State and prove central limit theorem.
   (b) Find the density of W = X + Y, where the densities of X and Y are assumed to be:
   f_X(x) = [u(x) - u(x - 1)], f_Y(y) = [u(y) - u(y - 1)] [8+8]

5. (a) Write the expression for expected value of a function of random variables and prove that the mean value of a weighted sum of random variables equals the weighted sum of mean values.
   (b) X is a random variable with mean $\bar{X} = 3$, variance $\sigma_X^2 = 2$.
      i. Determine the second moment of X about origin
      ii. Determine the mean of random variable y = where y = -6X +22. [8+8]

6. (a) Prove that autocorrelation function of a random process is even function of τ.
   (b) Prove that $R_{XX}(\tau) = R_{XX}(0)$. [8+8]

7. (a) A WSS noise process N(t) has an autocorrelation function $R_{NN}(\tau) = Pe^{-3|\tau|}$ where p is a constant. Find and sketch its power spectrum.
   (b) Consider the figure shown in figure 7.
   where X(t), Y(t) are random processes & X(t) is WSS. Find the relation between $S_{YY}(\omega)$ and $S_{XX}(\omega)$. [8+8]

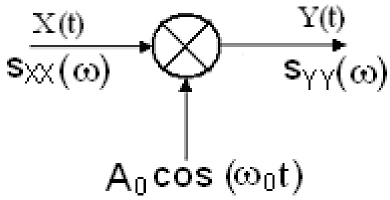

Figure 7

8. (a) A Signal x(t) = u(t) exp (-αt) is applied to a network having an impulse response h(t)= ω u(t) exp (-ω t). Here α & ω are real positive constants. Find the network response?
   (b) Two systems have transfer functions $H_1(\omega)$ & $H_2(\omega)$. Show the transfer function $H(\omega)$ of the cascade of the two is $H(\omega) = H_1(\omega) H_2(\omega)$.
   (c) For cascade of N systems with transfer functions $H_n(\omega)$, n=1,2,........N show that $H(\omega) = \pi H_n(\omega)$. [6+6+4]

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