Code No: RR210403 **Set No.1**

II B.Tech. I Semester Supplementary Examinations, May -2005
PROBABILITY THEORY & STOCHASTIC PROCESS
(Common to Electronics & Communication Engineering and Electronics & Telematics)

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

Answer any FIVE Questions
All Questions carry equal marks

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1. (a) Distinguish between mutually exclusive events and independent events.
   (b) A letter is known to have come either from LONDON or CLIFTON. On the postmark only the two consecutive letters 'ON' are legible. What is the Chance that it came from London? Give step-by-step answer.
   (c) Show that the chances of throwing six with 4,3or 2 dice respectively are as 1:6:18.

2. (a) Explain the Gaussian distribution with a neat sketches of pdF and cdF.
   (b) An analog signal received at the detector (measured in microvolts) may be modeled as a Gaussian random variable N (200,256) at a fixed point in time. What is the probability that the signal will exceed 240 μvs. what is the probability that the signal is larger than 240 μV, given that it is larger than 210 μVs?

3. (a) If the Random variable X has uniform distribution, find its variance.
   (b) Let X is a Gaussian random Variable with zero mean and variance σ^2. Let Y=X^2.Find mean of Random Variable Y.

4. Find the Auto correlation function and power spectral density of the Random process.
   x(t) = K Cos ($\omega ot + \theta$) Where θ is a Random variable over the ensemble and is uniformly distributed over the Range (0, 2π).

5. The input voltage to an RLC series circuit is a stationary Random process X(t) with E[x(t)]=2 and $R_{xx}(\tau) = 4 + \exp(-2\,|\tau|\,)$. Let Y(t) be the voltage across capacitor. Find E[Y(t)] and G_y(f).

6. (a) What do you understand by noise power spectral density?
   (b) How is the autocorrelation function of the White noise represented? What is its significance?

7. (a) Bring out the difference between narrowband and broadband noises.
   (b) Describe the quadrature representation of narrowband noise.

8. (a) Explain what do you understand by "Entropy and Channel capacity".
   (b) With respect to information transmission, explain the trade off between "S/N ratio and transmission Band width". Justify this from Shannon Hartley law.

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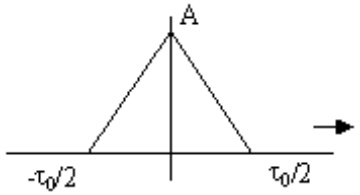
1. (a) State and prove Bayes theorem of probability.
   (b) In a single throw of two dice, what is the probability of obtaining a sum of at least 10?
2. (a) Explain the Rayleigh probability density function.
   (b) Find the mean value, the mean squared value and the cumulative distribution function for the Rayleigh distribution with parameter α ¿0, specified by the pdf $f(x) = \frac{x}{\alpha^2} \exp\left\{-\frac{1}{2}\frac{x}{\alpha}\right\}$.
3. (a) Prove that |Rxy(τ)| <= sqrt[Rxx(0)Ryy(0)] .
   (b) Find the mean and characteristic function of Binomial distribution.
4. (a) State the condition for wide sense stationary Random process.
   (b) Find the Auto Correlation function for white noise shown in the figure below.



5. Find the input auto correlation function, output autocorrelation and o/p spectral density of RC low pass filter, where the filter is subjected to a white noise of spectral density $N_0/2$.
6. (a) What are the characteristics of White noise?
   (b) Discuss the spectral distribution of thermal noise.
7. (a) What are the precautions to be taken in cascading stages of a network in the point of view of noise reduction?
   (b) What is the need for band limiting the signal towards the direction increasing SNR.
8. (a) Compare discrete and continuous channel with respect to information transmission.

(b) Derive an expression for channel capacity of a continuous channel in the presence of White Gaussian noise.

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1. (a) Explain the concept of random variable.
   (b) What is the probability of picking an ace and a king from a deck of 52 cards?
   (c) A box contains 4-point contact diodes and 6 alloy junction diodes. What is the Probability that 3 diodes picked at random contain at least two point contact Diodes?

2. (a) Derive an expression for, the error function of the standard normal Random variable
   (b) Lifetime of IC chips manufactured by a semiconductor manufacturer is approximately normally distributed with mean = 5x 10^6 hours and standard deviation of 5x 10^5 hours. A mainframe manufacturer requires that at least 95% of a batch should have a lifetime greater than 4x10^6 hours. Will the deal be made?

3. (a) Prove that moment generating function of the sum of two independent variables is the product of their moment generating function.
   (b) Let X and Y be independent random Variables, prove that Var (XY) = Var (X) Var (Y) if E[X] = E[Y] = 0.

4. Consider a Random binary waveform that consists of a sequence of pulses with the following properties.
   (a) Each pulse is of duration T_0
   (b) Pulses are Equally likely to be ± 1
   (c) All pulses are statistically independent
   (d) The pulses are not synchronized, that is, the starting time T of the first pulse is Equally likely to be anywhere between 0 and Tb.

   Find the Auto correlation and power spectral density function of x(t).

5. A Random process n(t) has a power spectral density g(f) =$\eta/2$ for -$\alpha \leq f \leq \alpha$ Random process is passed through a low pass filter which has transfer function H(f)=2 for$-f_m \leq f \leq f_m$ and H(f)= 0 otherwise. Find the PSD of the waveform at the o/p of the filter.

6. (a) What is shot noise? How is it qualified?

(b) How the spectral density of White noise is denoted.

7. Which of the following noise parameters is the true representation of noise in electrical circuits?

   (a) Noise figure

   (b) Noise temperature

   (c) Noise bandwidth

   Support your answer with the help of suitable examples.

8. (a) Describe the channel capacity of a discrete channel.

   (b) Explain Shannon Fano algorithm to develop a code to increase average information per bit.

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1. (a) Define Probability density function and obtain the relationship between probability and probability density.
   (b) Consider the probability density f (x) = a e $^{-b|x|}$ where x is a random variable whose allowable values range from x = - ∞ to ∞. Find:
      i. the CDF F (x)
      ii. the relationship between a and b. and
      iii. the probability that the outtcome x lies between 1 and 2.
2. (a) Derive an expression for the average value and variance associated with the Gaussian probability density function
   (b) The average life of a certain type of electric bulb is 1200 hours. What percentage of this type of bulbs is expected to fail in the first 800 hours of working? What percentage is expected to fail between 800 and 1000 hours? Assume a normal distribution with σ = 200 hours.
3. (a) Find the density function whose characteristic function is exp (-$|t|$).
   (b) Let X be a continuous random variable with pdf fX (x)=8/ x^3, x> 2. Find E[W] where W = X/3.
4. (a) Explain Ergodic random process.
   (b) State and prove properties of Auto correlation function.
5. (a) Derive the relation between PSDs of input and output random process of an LTI system.
   (b) X(t) is a stationary random process with zero mean and auto correlation $R_{XX}(\tau)\, e^{-2|\tau|}$ is applied to a system of function $H(w) = \frac{1}{jw+2}$. Find mean and PSD of its output.
6. (a) What is thermal noise? How is it quantified?
   (b) Describe the behavior of Zero mean stationary Gaussian bandlimited White noise.
7. (a) The noise figure of an amplifier at room temperature (T=290^o K) is 0.2db. Find the equivalent temperature.
   (b) Explain the concept of effective input noise temperature.

8. (a) Write a short notes on the role and use of Information theory to a communication engineer.

   (b) A card is drawn at random from ordinary deck of 52 playing cards. Find the information in bits that you receive when you are told that the card is a heart, a face card, and a heart face card.

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