Code.No: A109210401 | R09 | SET-1

II B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
PROBABILITY THEORY AND STOCHASTIC PROCESS
(COMMON TO ECE, ETM)

Time: 3hours **Max.Marks:75**

Answer any FIVE questions
All questions carry equal marks
- - -

1.a) Discuss discrete and continuous sample spaces with examples.
b) If a box contains 75 good diodes and 25 defective diodes and 12 diodes are selected at random, find the probability that at least one diode is defective. [7+8]

2.a) Distinguish between discrete and continuous random variables with examples.
b) An inspection plan calls for inspecting five chips and for either accepting each chip, rejecting each chip, or submitting it for reinspection, with probabilities of $p_1 = 0.70$, $p_2 = 0.20$, $p_3 = 0.10$ respectively. What is the probability that all five chips must be reinspected? What is the probability that none of the chips must be reinspected? [6+9]

3.a) Calculate E[X] when X is binomially distributed with parameters n and p.
b) The characteristic function for a Gaussian random variable X, having a mean value of 0, is

$$\Phi_X(\omega) = \exp(-\sigma_X^2 \omega^2 / 2)$$

Find all the moments of X using $\Phi_X(\omega)$. [7+8]

4.a) Derive the expressions for the distribution and density functions of sum of two statistically independent random variables.
b) Find the conditional density functions for the joint distribution

$$f_{X,Y}(x,y) = 4xy\, e^{-(x^2+y^2)} u(x) u(y)$$ [7+8]

5.a) Define joint central moments for two random variables X and Y and explain the covariance of two random variables.
b) Two random variables X and Y have means $\overline{X} = 1$ and $\overline{Y} = 2$, variance $\sigma_X^2 = 4$ and $\sigma_Y^2 = 1$, and a correlation coefficient $\rho_{XY} = 0.4$. New random variables W and V are defined by

V = -X + 2Y W = X + 3Y

Find:
i) The means, and
ii) The correlation coefficients ρ_{VW} of V and W. [6+9]

6.a) Explain the following
i) Wide – sense stationary process and
ii) Strict – sense stationary process.
b) Discuss about the following ergodic process
i) Mean Ergodic process.
ii) Correlation ergodic process. [7+8]

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7.a) Derive the relationship between the auto – correlation function and the power spectral density of a random process?

b) Let the auto correlation function of a certain random process X(t) be given by

$$R_n(\tau) = \frac{A^2}{2}\cos(\omega_0 \tau)$$

Obtain an expression for its power spectral density $S_n(\omega)$. [7+8]

8.a) Explain the following

i) Effective noise temperature

ii) Average noise figure

b) Two conductances G_1 and G_2 are at the same temperature 300^0 K. Find the voltage power density spectrum at the terminals formed by the series combination of these conductances. [8+7]

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Time: 3hours **Max.Marks:75**

Answer any FIVE questions
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- - -

1.a) State and prove the Bayes' theorem.
b) A box with 15 transistors contains five defective ones. If a random sample of three transistors is drawn, what is the probability that all three are defective? [7+8]

2.a) State and prove the properties of conditional density function.
b) The probability density function (Pdf) of the amplitude of speech waveforms is found to decay exponentially at a rate α, so the following Pdf is purposed:
$f_X(x) = Ce^{-\alpha|x|}$; $-\infty < x < \infty$, Find the constant C. [7+8]

3.a) Calculate $E[X^3]$, if X is uniformly distributed.
b) State and prove any four properties of characteristic function. [7+8]

4.a) State and prove properties of the joint distribution for two random variables.
b) Find the marginal densities of X and Y using the joint density $F_{X,Y}(x,y) = 2u(x)u(y)\exp\left[-\left(4y+\frac{x}{2}\right)\right]$. [7+8]

5.a) Explain Gaussian density function for N random variables.
b) State and prove the properties of joint moment generating function. [7+8]

6.a) Explain the following with examples
i) Discrete time stochastic process and
ii) Continuous time stochastic process.
b) Explain the first and second order stationary random processes. [8+7]

7.a) "The Power Spectral density of any random waveform and its autocorrelation function are related by means of Fourier transform". Prove and illustrate the above statement.
b) The power Spectral density of X(t) is given by
$$S_{XX}(\omega) = \begin{cases} 1+\omega^2 & for\,(\omega) < 1 \\ 0 & otherwise \end{cases}$$
Find the autocorrelation function. [8+7]

8.a) Explain the following
i) Available power density
ii) Effective noise temperature
iii) Noise figure
b) A mixer Stage has a noise figure of 20dB and this is preceded by an amplifier that has a noise figure of 9dB and an available power gain of 15 dB. Calculate the overall noise figure referred to the input. [9+6]

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II B.TECH – I SEM EXAMINATIONS, NOVEMBER - 2010
PROBABILITY THEORY AND STOCHASTIC PROCESS
(COMMON TO ECE, ETM)

Time: 3hours **Max.Marks:75**

Answer any FIVE questions
All questions carry equal marks
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1.a) Define the following two kinds of probability.
i) Probability as a measure of frequency of occurrence
ii) Probability based on an axiomatic theory.
b) A coin is to be tossed until a head appears twice in a row. What is the sample space for this experiment? If the coin is fair, what is the probability that it will be tossed exactly four times? [8+7]

2.a) State and prove any four properties of probability distribution function.
b) Find the value of the constant k so that

$$f(x) = \begin{cases} kx^2(1-x^3), & 0 < x < 1 \\ 0, & otherwise \end{cases}$$

is a proper density function of a continuous random variables. [10+5]

3.a) Calculate E[X] if X is a Poisson random variable with parameter λ.
b) Show that a linear transformation of a Gaussian random variable produces another Gaussian random variable. [7+8]

4.a) The joint Pdf is $f_{X,Y}(x,y) = \frac{1}{18} e^{-(x/6+y/3)} \quad for \ x \geq 0, y \geq 0$
Show that X and Y are statistically independent random variables.
b) Discuss the Central limit theorem. [8+7]

5.a) State and prove the properties of covariance function.
b) State and prove the properties of joint moment generating function. [7+8]

6.a) What is the importance of covariance function?
b) State and prove the properties of auto correlation function. [5+10]

7.a) Derive the relationship between power spectral density of input and output random process of an LTI system.
b) A random process X(t) whose mean value is 2 and auto correlation function $R_{XX}(\tau) = 4^{e-2|\tau|}$ is applied to a system whose transfer function is $\frac{1}{2+jw}$. Find the mean value, auto correlation, power density spectrum and average power of output signal Y(t). [6+9]

8.a) Explain the following

i) Extraterrestrial noise   ii) Shot noise   iii) Thermal noise

b) Two resistors, 22 kΩ and 47 kΩ are at room temperature (300^0 K). Calculate, for a bandwidth of 100 KHz, the thermal noise voltage

i) for each resistor,

ii) for the two resistors in series and

iii) for the two resistors in parallel. [6+9]

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Time: 3hours **Max.Marks:75**

Answer any FIVE questions
All questions carry equal marks
- - -

1.a) Define conditional and joint probabilities with respect to probability as a measure of frequency of occurrence and probability based on as axiomatic theory.

b) We are given a box containing 5000 transistors, 1000 of which are manufactured by company X and the rest by company Y. 10% of the transistors made by company X are defective and 5% of the transistors made by company Y are defective. If a randomly chosen transistor is found to be defective, find the probability that it came from company X. [6+9]

2.a) What are the conditions required for a function to be random variable?

b) The waiting time X of a customer in a queuing system is zero if he finds the system idle, and an exponentially distributed random length of time if he finds the system busy. The probabilities that he finds the system idle or busy are P and 1-P, respectively. Find the cumulative distribution function of X. [5+10]

3.a) Calculate the expectation of an exponential distributed random variable having parameter λ.

b) Define the moment generating function(MGF) and discuss about the disadvantage of MGF over the characteristic function. [9+6]

4.a) State and prove any four properties of joint the density function of two random variables.

b) Find the marginal densities of X and Y using the joint density.

$$F_{x,y}(x,y) = 2u(x)\,u(y)\ \exp[-(4y+\frac{x}{2})].$$ [8+7]

5.a) Define covariance of random variables X and Y and explain correlation coefficient.

b) State and prove the properties of joint characteristic function. [7+8]

6.a) State and prove any four properties of cross-correlation function.

b) Explain the classification of random processes. [8+7]

7.a) State and prove any four properties of the power spectral density.

b) Determine which of the following functions are valid power density spectrum and why?

i) $\dfrac{\cos 8(\omega)}{2+\omega^4}$

ii) $e^{-(\omega-1)^2}$ [8+7]

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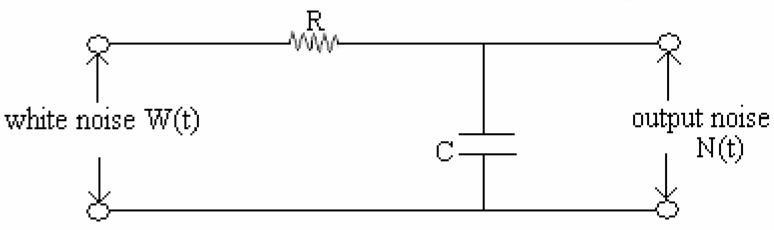
8.a) Explain the following
   i) Available noise power spectral density
   ii) White noise and its mathematical representation.

b) A white noise process W(t) of zero mean and power spectral density $\frac{\eta}{2}$ is applied to a RC low-pass filler shown is figure. Determine the power spectral density and autocorrelation function of the filtered noise at the output. [6+9]



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