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B.E DEGREE EXAMINATIONS: APRIL/MAY 2011

Fourth Semester

ELECTRONICS AND COMMUNICATION ENGINEERING

U07MA403: Random Processes

Time: Three Hours **Maximum Marks: 100**

Answer All Questions

PART A (10 x 1 = 10 Marks)

1. If var(x) = 4 then var(3x+8),where x is a random variable is

   a) 36 b) 64 c) 9 d) 63

2. A box contains 4 bad and 6 good tubes. Two are drawn out from the box at a time one of them is tested and found to be good. What is the probability that the other one is also good?

   a) 2/3 b) 1 c) 1/3 d) 3/6

3. If X follows poisson distributions with parameter λ= 1/2, then the mean and variance of X.

   a) Mean =var =1 b) Mean =var =1 /2 c) Mean =var =0 d) Mean =var =2

4. The mgf of geometric distribution is

   $a) \frac{e^t}{2-e^t}$ b) $\frac{p}{1-qe^t}$ c) $\frac{1-qe^t}{p}$ d) $(q+pe^t)^n$

5. Two random variables are said to be uncorrelated if correlation coefficient is -----------------.

   a) 1 b) 0 c) c(x,y) d) -1

6. The regression coefficient of the line y on x is

   a) $r\frac{\sigma y}{\sigma x}$ b) $r\frac{\sigma x}{\sigma y}$ c) rσy d) rσx

7. The mean of the poisson processes.

   a) λ b) p/q c) λt d) 1/λ.

8. The random processes is a random variable which is -----------

   a) dependent on time b) independent on time c) dependent on sample d) indepent on space

9. The mean of the stationary process {x(t)}, whose ACF is given by $R(\tau) = 16 + \frac{9}{1+16\tau^2}$ is

   a) 16 b) 4 c) 9 d) 3

10. The power spectral density of a real valued random process is -------- function of frequency.

    a) even b) odd c) harmonic d) regular

PART B (10 x 2 = 20 Marks)

11. State Bayes theorem.

12. If A and B are events with P(A) = 3/8, P(B) = ½ and $P(A\cap B)$ = ¼. Find $P(\bar{A} \cap \bar{B})$.

13. State any two properties of normal distribution.

14. Find the mgf of uniform digit its pdf is f(x) = 1/2a, -a<x<a

15. State central limit theorem.

16. If two random variables X and Y have pdf f(x,y) = k$e^{-(2x+y)}$, x , y > 0. Find k.

17. Write the classification of random processes.

18. When a random process said to be ergodic?

19. State wiener- khinchine theorem.

20. Define memoryless system.

PART C (5 x 14 = 70 Marks)

21.a) (i) An urn contains 10 white and 3 black balls. Another urn contains 3 white and 5 black balls.Two balls are drawn at random from the first urn and placed in the second urn and then 1 ball is taken at random from the later. What is the probability that it is a white ball?

(ii) Let the random variable X have the pdf

$$f(x) = \begin{cases} \frac{1}{2} e^{-x/2}, x > 0 \\ 0, otherwise \end{cases}$$

find mean and variance of X.

(OR)

b) (i) A continuous random variable X has the pdf f(x) = kx^2 e^{-x} ,x $\geq$ 0 . Find the r^{th} moment of X about the origin. Hence find the mean and variance of X.

(ii) If A and B are independent events then

1. A and $\bar{B}$ are independent.
2. $\bar{A}$ and B are independent

22. a) (i) Derive the poisson distribution as a limiting case of binomial distribution.

(ii) Find the mgf, mean and variance of exponential distribution.

(OR)

b) (i) X is a normal variate with mean 30 and standard deviation 5. Find the following

1. P(26$\leq X \leq 40$) 2.P(X$\geq$ 45)

(ii) Six dice are thrown 729 times. How many times do you expect atleast 3 dice show a 5 or 6?

23. a) (i) The joint probability density function of a bivariate random variable (X, Y) is

$$f(x, y) = \begin{cases} k(x+y) & ,0 < x < 2; 0 < y < 2 \\ 0, & otherwise \end{cases}$$,where k is a constant.

1. Find k 2. Marginal pdf of X

(ii) The two lines of regression are 8x – 10y + 66 = 0, 40x – 18y – 214 = 0. The variance of x is 9.Find 1. The mean values of x and y.

2. correlation coefficient between x and y.

(OR)

b) (i) Three balls are drawn at random without replacement from a box containing 2 white, 3 red and 4 black balls. If X denotes the number of white balls drawn and Y denotes the number of red balls drawn, find the joint probability distribution of (X, Y).

(ii) The life time of a certain kind of electric bulb may be considered as a random variable with mean 1200 hrs and s.d 250 hrs. Find the probability that the average life time of 60 bulbs exceeds 1250 hrs using central limit theorem.

24. a) (i) Show that the random processes x(t) = Acos λt +Bsinλt where A and B are random variables is wss if 1.E(A) = E(B) = 0 2. $E(A^2) = E(B^2)$ 3.E(AB) = 0.

(ii) Prove that the random process {X(t)} with constant mean is mean ergodic if $\lim_{T\to\infty} \frac{1}{4T^2} \int_{-T}^{T} \int_{-T}^{T} c(t_1, t_2)\, dt_1 dt_2 = 0$.

(OR)

b) (i) Find the matrix of the states 0,1,2 of the markov chain with the tpm

$$P = \begin{pmatrix} 0 & 1 & 0 \\ 1/2 & 0 & 1/2 \\ 0 & 1 & 0 \end{pmatrix}$$

(ii) Show that the sum of two independent poisson processes is a poisson processes.

25.a) (i) Define autocorrelation function. Find the mean and variance of {X(t)} for $R_{xx}(\tau) = \frac{25\tau^2+36}{6.25\tau^2+4}$ (6)

(ii) The cross power spectrum of real random processes X(t) and Y(t) is given by

$$S_{xy}(\omega) = \begin{cases} a - \frac{jb\omega}{W}, & |\omega|<1 \\ 0 & ,o.w \end{cases}$$ (8)

Find the crosscorrelation function.

(OR)

b) Let {x(t)} be a WSS random input process to an LTI system with impulse response h(t) and let {y(t)} be the corresponding process. show that

1. $R_{xy}(\tau) = R_{xx}(\tau) * h(\tau)$
2. $R_{yy}(\tau) = R_{xy}(\tau) * h(-\tau)$
3. $S_{xy}(\omega) = S_{xx}(\omega) H(\omega)$
4. $S_{yy}(\omega) = S_{xx}(\omega) H^{*}(\omega)$

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