SIDDHARTH INSTITUTE OF ENGINEERING &TECHNOLOGY:: PUTTUR
ELECTRONICS & COMMUNICATON ENGINEERING

QUESTION BANK (DESCRIPTIVE)

Subject with Code : (18EC0409) PROBABILITY THEORY AND STOCHASTIC PROCESSES

Course & Branch: B. Tech – ECE **Year & Semester:** II & II

Regulation: R18

UNIT-I
INTODUCTION TO PROBABILITY AND RANDOM VARIABLES

1. (a) Define the following with examples. [L1][CO1][5M]
   i. Sample space ii. Event iii. Mutually exclusive events. iv. Independent events.
   (b)Two cards are drawn from a 52 card deck. [L1][CO1][5M]
   i. Given the first card is queen, what is the probability that the second is also a queen?
2. (a) Explain conditional distribution and density function .state its properties [L6][CO1][5M]
   (b) In a bolt factory machine A,B,C Manufacture 30%,30%,40% of the total output respectively. From their outputs,4%,5%,3% are defective bolt.A bolt is drawn at random and found to be defective. What are the probabilities that is was manufactured by machines A, B, C? [L6][CO1][5M]
3. (a) Discuss Joint and conditional probability. [L1][CO1][3M]
   (b) When are two events said to be mutually exclusive? Explain with an example. [L1][CO1][3M]
   (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. [L6][CO1][4M]
4. (a) When two dice are thrown, find the probability of getting sum of 10 or 11? [L6][CO1][5M]
   (b) An experiment consists of rolling a single die, two events are defined as, A ={ 6 shown up } B = {2 or 5 shows up } [L6][CO1][5M]
   i. Find P(A) & P(B) ii. Define third event C so that P(c) = 1- P(A)-P(B).
5. (a) State and prove Bayes theorem of probability. [L4][CO1][5M]
   (b) An ordinary 52 Card deck is thoroughly shuffled. You are dealt four cards up. What is the probability that all four cards are fives. [L6][CO1][5M]
6. Define distribution and density function. State its properties. [L1][CO1][5M]
7. (a)Explain the different types of random variables. [L1][CO1][5M]
   (b)Discuss Rayleigh and exponential distribution function. [L1][CO1][5M]
8. (a) Define probability [L1][CO1][5M]
   i. Mathematical approach.
   ii. Relative frequency approach
   iii.set theory approach.
   (b) A die is tossed find the probabilities of the event A = {odd number shows up} , B ={ number larger than 3 } showsup. Find $A \cup B$ and $A \cap B$. [L6][CO1][5M]
9. (a) A shipment of components consists of three identical boxes.one box contains 2000 components of Which 25% Are defective, the second box has 5000 components of which 20% are defective and the Third box contains 2000 components of which 600 are defective. A box is selected at random and a Component is removed at random from the box. Whats the probability that this component is defective? What is the probability that is came from the second box? [L6][CO1][5M]
   (b) In a single throw of two dice, what is the probability of obtaining a sum of at least 9.

[L6][CO1][2M]

10. (a)State Baye's Theorem. [L4][CO1][2M]
(b)What are the conditions for a function to be a Random variable. [L1][CO1][2M]
(c)What are the conditions to be satisfied for the statistical independence of three events A, B and C. [L1][CO1][2M]

(d)Explain about certainity and uncertainity with suitable examples [L1][CO1][2M]
(e) Define Exhaustive event & mutually exclusive event. [L1][CO1][2M]

UNIT –II

MULTIPLE RANDOM VARIABLES AND OPERATIONS ON MULTIPLE RANDOM VARIABLES

1. (a) Discuss the properties of conditional distribution function. [L4][CO1][5M]
(b) If the joint PDF of two dimensional random variable (x, y) is given by: [L6][CO1][5M]
$f_{X,Y}(x,y) = 2$; for $0 \le X \le 1, 0 \le Y \le x$
$= 0$; otherwise
Find the marginal density function of X and Y.
2. (a)Random variable X and Y have the density: [L6][CO2][5M]
$f_{X,Y}(x,y) = 1/24$; for $0 \le X \le 6, 0 \le Y \le 4$
0 ; elsewhere
What is the expected value the function $g(X,Y)=(X,Y)^2$?
(b) Briefly explain about jointly Gaussian random variables. [L1][CO2][5M]
3. The joint pdf is given as $f_{x,y}(x,y) = e^{-(2x+y)}$ for $x \ge 0$ and $y \ge 0$. [L6][CO2][10M]
Find (a) the value of A and (b) the marginal density functions.
4. (a)Two random variable X and Y with joint density function [L6][CO2][10M]
$f_{XY}(x,y) = Ae^{-(2x+y)}$ $x \ge 0, \ y \ge 0$
0 Otherwise
i)Find 'A' ii)Find Marginal density functions?
5. The joint probability density function of two random variables X and Y is given by [L6][CO2][10M]
$f_{XY}(x,y) = c(2x+y)$ $0 \le x \le 1 \ \ 0 \le y \le 2$
0 Otherwise
i)Find 'c' ii)Find Marginal density functions?
6. The joint pdf of two random variables X and Y is given by [L6][CO2][10M]
$f_{X,Y}(x,y) = K(x^2+2y)$; $x \ge 0, \ y \ge 0$
$= 0$; otherwise
Find (a) The 'K' value (b) $f_X(x)$ & $f_Y(y)$
7. (a) Define and explain joint distribution function and joint density function of two random variables X and Y. [L1][CO2][5M]
(b) State and prove the properties of joint distribution function. [L4][CO2][5M]
8. Explain conditional distribution and density function –point conditioning and interval conditioning? [L1][CO2][10M]
9 .(a). If the function [L6][CO2][5M]
$f_{XY}(x,y) = be^{-2x}\cos(y/2)$ $0 \le x \le \pi$ $0 \le y \le \pi$
0 Elsewhere
Where 'b' is a positive constant is a valid joint probability density function. Find 'b'
(b) Explain the sum of two random variables and multiple random variables [L1][CO2][5M]
10. (a).State Central Limit Theorem? [L4][CO2][2M]
(b).Define the expected value of a function of two random variables? [L1][CO2][2M]

(c).How interval conditioning is different from point conditioning. [L4][CO2][2M]
(d).Define joint moments about the origin. [L1][CO2][2M]
(e).Write a brief short note on joint central moments. [L1][CO2][2M]

UNIT –III

RANDOM PROCESS- TEMPORAL CHARACTERISTICS

1. What is ACF? State and explain any four properties of ACF? [L1][CO3][10M]
2. Explain about first order,second,wide-sense and strict sense stationary process. [L1][CO3][10M]

3. A Show that the auto correlation function of a stationary random process is an even function of τ. [L4][CO3][5M]
   (b) Give the classification of random processes. [L1][CO3][5M]
4. A random process is defined by x(t) =At where A is a continuous random variable uniformly Distributed on (0,1) and t represents time. Find (a) E [x (t)] (b) Rxx [t, t + τ] (c) Is the process stationary? [L6][CO3][10M]

5 (a) A random process is defined as X(t)=A sin(ωt+Θ),where A is a constant and Θ is a random Variable distributed over (π,-π),check X(t) is stationary. [L6][CO3][5M]

(b). Prove the following 1. $|R_{XX}(\tau)| \leq R_{XX}(0)$ 2. $R_{XX}(-\tau)= R_{XX}(\tau)$ 3. $R_{XX}(0) = E[X^2(t)]$ [L4][CO3][5M]

6. (a) State the conditions for wide sense stationary random process. [L4][CO3][5M]
   (b) Write short notes on ergodic random processes. [L1][CO3][5M]
7. What is cross correlation function of a random process? state and explain any four properties of Cross correlation function of a random process? [L1][CO3][10M]
8 (a) Explain about mean-ergodic process. [L1][CO3][5M]
   (b).If x (t) is a stationary random process having mean = 3 and auto correlation function: $R_{XX}(\tau) = 9 + 2e^{-|\tau|}$. Find the mean and variance of the random variable. [L6][CO3][5M
9. (a) Explain the significance of auto correlation. [L1][CO3][5M]
   (b) Find auto correlation function of a random process whose power spectral density is given by $4/(1+(\omega^2/4))$ [L6][CO3][5M]
10.(a).Test the function ''$e^{\tau}u(\tau)$''for a valid PSD. [L4][CO3][2M]
   (b).Define WSS random process. [L1][CO3][2M]
   (c).What is a stationary process? Explain. [L4][CO3][2M]
   (d).Determine the mean square value of a random process with autocorrelation function $R_{XX}(\tau)=e^{-|\tau|}$ [L6][CO3][2M]
   (e).Write the condition two WSS process X(t) and Y(t)are jointly wide sense stationary? [L1][CO3][2M]

UNIT –IV

RANDOM PROCESS- SPECTRAL CHARACTERISTICS

1. (a) Briefly explain the concept of cross power density spectrum. [L1][CO4][5M]
   (b) Find the cross correlation of functions sin ωt and cosωt. [L6][CO4][5M]
2. (a) The power spectral density of a stationary random process is given by [L6][CO4][5M]

$S_{xx}(\omega) = A; \quad -k < \omega < k$
$0; \quad$ otherwise
Find the auto correlation function.

(b)Discuss the properties of power spectral density. [L4][CO4][5M]

3. (a)Discuss the properties of cross power density spectrum. [L4][CO4][5M]
   (b)Discuss the relation between cross power spectrum and cross correlation function. [L4][CO4][5M]

4. State and prove properties of PDS [L4][CO4][10M]
5. (a) If the PSD of x(t) is $S_{XX}(\omega)$.Find the PSD of dx(t)/dt. [L6][CO4][5M]
   (b)Find the PSD of a stationary random process for which auto correlation is $R_{XX}(\tau)=6e^{-\alpha|\tau|}$ [L6][CO4][5M]
6. (a) State and prove wiener –khintchins relations [L4][CO4][5M]
   (b) Prove that 1. $S_{XX}(-\omega)= S_{XX}(\omega)$ 2. $S_{XY}(\omega)= S_{YX}(-\omega)$ [L4][CO4][5M]
7. The psd of X(t) is given by [L6]CO4][10M]

   $S_{xx}(\omega) = 1+\omega^2$ for $|\omega|<1$

   0; otherwise

   Find the auto correlation function.

8. The power spectral density of a stationary random process is given by [L6][CO4][10M]

   $S_{xx}(\omega)=A$ $-K\leq\omega\leq K$

   0 ; otherwise

   Find the auto correlation function.

9. (a)A stationary random process X(t) has auto correlation $R_{XX}(\tau)=10+5\cos(2\tau)+10e^{-2|\tau|}$. Find the dc and ac powers of X(t). [L6][CO4][5M]

   (b).Prove that $S_{XX}(\omega)=S_{XX}(-\omega)$ [L4][CO4][5M]

10. (a).Write some properties of auto Power density Spectrum? [L4][CO4][2M]
    (b).Derive the power spectral density at zero frequency is equal to the area under the curve of the autocorrelation $R_{xx}(\tau)$? [L4][CO4][2M]

    (c).Derive the formula for power spectral density is an even function? [L4][CO4][2M]

    (d).Derive the formula for time average of the mean square value of WSS random process is equal to the area under the curve of the power spectral density? [L4][CO4][2M]

    (e).Derive the formula for sxy(w)=0 &syx(w)=0,if X(t) and Y(t) are orthogonal? [L4][CO4][2M]

UNIT –V
LINEAR SYSTEMS WITH RANDOM INPUTS

1. (a). Derive the relation between PSDs of input and output random process of an LTI system. [L4][CO5][5M]

   (b). Discuss about cross correlation between the input X (t) and output Y (t). [L4][CO5][5M]

2. (a) Explain about LTI system [L1][CO5][5M]

   (b) Find the power density spectrum of response of a linear system [L4][CO5][5M]

3. (a) X(t) is a stationary random process with zero mean and auto correlation $R_{xx}(t)=e^{-2|\tau|}$ is applied to a system Of function $H(\omega)=1/j\omega+2$.Find mean and PSD of its output. [L6][CO5][5M]
   (b) Find the auto correlation of the response Y(t). [L4][CO5][5M]

4. Write notes on: [L1][CO5][10M]
   (a) Band Pass random process.
   (b) Band limited random process
   (c) Narrow band random process.
5. (a) Derive the relation between PSD of input and output random process of an LTI system. [L4][CO5][5M]
   (b) Discuss about cross correlation between the input X (t) and output Y (t) [L4][CO5][5M]
6. Derive the expressions for mean. Auto correlation cross correlation and PSD of response of a linear System [L4][CO5][10M]
7. (a) How mean of the system response Y(t) is calculated? [L4][CO5][5M]
   (b) Write different types of band pass processes with band limited processes. [L1][CO5][5M]
8. (a)Define mean value of system response. [L4][CO5][5M]
   (b)Find mean square value of Y(t). [L4][CO5][5M]
9. (a) A WSS random process x(t) is applied to the input of an LTI system whose impulse response is $5te^{-2t.}$. The mean of x(t) is 3.Find the mean output of the system [L6][CO5][5M]
   (b) Give any two spectral characteristics of the system response. [L1][CO5][5M]
10. (a) Write on a brief note on auto correlation function of output response? [L1][CO5][2M]
    (b).Define mean square value of output response. [L1][CO5][4M]
    (c).Define band pass random processes [L1][CO5][4M]

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UNIT –I

INTODUCTION TO PROBABILITY AND RANDOM VARIABLES

1. The Density function can be obtained by _____ the Distribution function [ ]
   A) Differentiating B) Integrating C) Average D) Expectation
2. Nature or prediction of random signal is example of …….. [ ]
   A) Discrete Finite B) Discrete Infinite C) Continuous Finite D) Continuous Infinite
3. Obtaining a number in spinning pointer on a wheel is an example of ……. [ ]
   A) Discrete Finite B) Discrete Infinite C) Continuous Finite D) Continuous Infinite
4. The Event of an experiment gives……. [ ]
   A) All characteristics B) Specific Characteristics C) Both A and B D) None
5. The no. of events in an experiment with N elements is …….. [ ]
   A) 1 B) 2 C) N D) 2^N
6. A Random variable is a function of …….. [ ]
   A). Negative Values B)Positive Values C)Real Values D). None
7. The first condition for a function to be a Random variable is …….. [ ]
   A). Multi valued B).Single Valued C). Not valued D). None
8. ……. case is usually the least important type of Random Variable [ ]
   A)Discrete B).Continuous C)Mixed D). None
9. The function $F_X x$ is called as……function. [ ]
   A) Cumulative Density B) Cumulative Distribution C) Both A & B D). None
10. The Uniform probability density function in the range (a , b) can be expressed as…… [ ]
    A) ab B) b/a C). 1/(b-a) D).1/(b + a)
11. Probability can be defined as a function of. [ ]
    A) Sample space B) Trail C) Event D) Moments
12. The Joint Probability of two mutually exclusive events is . [ ]
    A) Zero B) Not zero C) Infinite D) Finite
13. The no. of permutations are always greater than the . [ ]
    A) no. of combinations B) Sum of combinations C) Only one combination D) Cannot Determine
14. The Distribution function can be obtained by the Density function. [ ]
    A) Differentiating B) Integrating C) Average D) Expectation
15. The Set of all possible outcomes in any given experiment is called……. [ ]
    A) Sample space B) Event C) Probability D) Mathematical Model

16. A∩ (B∪ C) is expressed as [ ]

A) A∪ C)∩ C B) (A∪ B)∩ (A∪ C) C) (A∩ B)∪ C D) (A∩ B)∪ (A∩ C)

17. Let S_1 and S_2 be the sample space of two sub experiments. The combined sample space S is [ ]

A) S_1/S_2 B) S_1*S_2 C) S_1-S_2 D) S_1+S_2

18. Let A be any event defined on a sample space S, then P(A) is [ ]

A) -1 B) 1 C) 0 D) ∞

19. Three events A1, A2, A3 are said be independent along the axis if and only if they are independent as a triple. Then P(A∩ B∩ C) [GATE:2007] [ ]

A) P(A1)P(A2) B) P(A1)P(A2)P(A3) C) P(A2)P(A3) D) P(A1)P(A3)

20. The probability of impossible event is [ ]

A)1 B) 0 C) 0.5 D) 0.8

21. If S1 and S2 are sample spaces of two experiments then sample space of combined experiment is_____ [ ]

A)S1 B) S2 C)S1.S2 D). 0

22. The probability of getting a red king card from a pack of 52 cards is_____ [ ]

A)13/52 B)12/52 C)2/13 D) 4/52

23.if A and B are disjoint then joint probability of two events P(AU B) is___ [ ]

A). P(A) B). P(B) C).P(A)+P(B) D).none

24.For independent events P(A∩B)=_____ [ ]

A).P(A) P(B) B). P(A) /P(B) C). P(B) D) 0

25.A random variable X is defined as 0≤X≤2.Then X is ____random variable [ ]

A) Continuous B) discrete C) mixed D) none

26. $F_X(-\infty)$=_____ [ ]

A)0 B).1 C) $F_X(x)$ D).none

27. The derivative of the distribution function is called__function [ ]

A). binomial B) marginal density C) probability density D).none

28.If two events are statistically independent then P (A/B)=_____ [ ]

A) P(A) B) P(B) C) P(A) P(B) D)P(A)+P(B)

29. From the axioms of the probability P(A) is_____ [ ]

A)≤1 B) ≤0 C). ≥0 D).1

30. If A and B are two independent events then P(A/B)=_____ [ ]

A).P(A) B) P(B) C) P(A)+P(B) D). 0

31.The probability of getting exactly three tails on tossing two coins is_____ [ ]

A)1/9 B).3/9 C).1 D). 0

32) if A and B are mutually exclusive then joint probability of two events P(AU B) is [ ] (GATE 2011)

A). P(A) B) P(B) C)P(A)+P(B) D). none

33. A random variable X is defined as 0.5≤X≤5.2.Then X is _random variable [ ]

A).continuous B).discrete C).mixed D) none

34. P(x1<X≤x2) =_____ [ ]

A)$F_X(x1)$ B). $F_X(x2)- F_X(x1)$ C). $F_X(x1)- F_X(x2)$ D)none

35. The derivative of the Gaussian distribution function is called _function [ ]

A) binomial density B) Gaussian density C) Poisson density D) none

36. The probability of getting red king from a regular pack of 52 cards is___ [ ] (GATE 2010)

A) 1/52 B).4/52 C) 2/52 D) 0

37. If S1 and S2 are sample spaces of two experiments where S1 has 5 elements and S2 has 4 elements. Then
the sample space of combined experiment has_____ [ ]
A) 9 B) 20 C) 10 D). none

38. The probability of event A is 0.8 then P(A)=_____ [ ]
A) 0 B)1 C) 0.2 D)0.4

39.The probability of getting an odd number on rolling a die is ___ [ ]
A)1/3 B) 3/6 C)1/7 D) none

40. The area under probability density function is equal to_____ [ ]
A) 0 B) 1 C)∞ D)none

UNIT –II

MULTIPLE RANDOM VARIABLES AND OPERATIONS ON MULTIPLE RANDOM VARIABLES

1. m_{10} is ……Order Moment [ ]
A). Zero B). First C) Second D) Third

2. m_{11} is ……Order Moment [ ]
A). Zero B).First C) Second D). Third

3. The correlation of two Random Variables X and Y is ……Order Moment [ ]
A). Zero B). First C) Second D) Third

4. If two Random Variables X and Y are Orthogonal, then their correlation is……. [ ]
A). Zero B)+1 C)-1 D). Infinite

5. The covariance of two Random Variables X and Y is …… Order central Moment [ ]
A). Zero B). First C)Second D). Third

6. The Normalized second order central moment is called as ……. [ ]
A). Density B). Correlation C). Covariance D).Correlation coefficient

7. If two random variables X and Y are independent, then the covariance is……. [ ]
A). Infinite B) +1 C) -1 D). Zero

8. For two random variables X and Y, Var(X-Y)= …… [ ]
A). Var(X) + Var(Y) + C_{XY} B). Var(X) + Var(Y) - C_{XY}
C). Var(X) + Var(Y) - 2C_{XY} D). Var(X) + Var(Y) + 2C_{XY}

9. For two random variables X and Y, cov(aX , bY) = …… [ ]
A) aC_{XY} + bC_{XY} B). (a+ b)C_{XY} C).(a- b)C_{XY} D) abC_{XY}

10. Gaussian random variables are completely defined from their……. [ ]
A). means B). variances C). covariance D). All the above

11. If Gaussian random variables are uncorrelated, then they are [ ]
A).Statistically independent. B). statistically dependent. C). Both (D). Cannot determine

12. The linear transformations of Gaussian random variables are. [ ]
A) not Gaussian B). Gaussian C).Poisson D). All

13. cov (X + a, Y + b) = [ ]
A). cov (aX,bY) B)cov (a,b) C)a+cov (X,Y)+b D) cov (X,Y)

14. If X and Y are two random variables, then the covariance is C_{XY} = [ ]
A). R_{XY} B).R_{XY}– E[X]E[Y] C). R_{XY}+E[X]E[Y] D).E[XY]

15. If C_{XY} = 0 then the two random variables and X and Y are. [ ]
A) Dependent B) Orthogonal C) independent D). B & C

16. The mean of a random variable X, is also known as_____ [ ]

A). skew of X B).variance of X C) Expectation of X D)none

17.The 1st moment about mean is equal to_____ [ ]

A) 0 B) 1 C) E[X] D). ∞

21. The second central moment is also known as_____ [GATE:2011] [ ]

A). mean B). Variance C) Standard deviation D) Skew

22. The joint characteristic function is used to find_____ [ ]

A)joint moment's B).joint pdf C).mean D)none

23. A transformation T is called monotonically decreasing if_____for x1<x2 [ ]

A)T(x1)>T(X2) B). T(x1)=T(X2) C). T(x1)<T(X2) D) none

24. $F_{X,Y}(-\infty,-\infty)$=_____ [ ]

A)2 B). 0 C)1 D). ∞

25. The joint moment m11 is_____ [ ]

A) correlation B).covariance C). Variance D) none

26. In point conditioning the conditional density function $f_{X,}(x/y)$ =_____ [ ]

A). $f_{X,Y}(x,y)$ B)$f_{X,Y}(x,y)/f_Y(y)$ C). $f_Y(y)$ D) none

27. The conditional density function $f_Y(Y/X\leq x)$ for independent X,Y given as [ ]

A). $f_{X,}(x)$ B) $f_{Y,}(y)$ C). $f_{X,}(x,y)$ D) none

28. If Gaussian random variables are uncorrelated they are_____ [ ]

A)Independent B) dependent C). a or b D) none

31. m1 of random variable X= _____ [ ]

A). 0 B).1 C) E[X] D) none

32. $F_{X,Y}(\infty,\infty)$=_____ [ ]

A). 0 B) 1 C) ∞ D) none

33. The third central moment of a random variable X, is also known as___ [ ]

A) skew of X B) variance of X C) Expectation of X D) none

34. The 2nd moment about origin is equal to_____ [ ]

A) $E[X^3]$ B).E[X] C) $E[X^2]$ or (Mean Square value of X) D). ∞

35. The coefficient of skewness is represented as_____ [ ]

A)m_0 B) μ_1 C) ρ D)none

36. The joint characteristic function Φxy(0,0)=_____ [ ]

A)0 B) 1 C)∞ D). none

37. A transformation of a Gaussian random variable is_____ [ ]

A) Poisson B).binomial C) Gaussian D)uniform

38. $F_{X,Y}(\infty,y)$=_____ [ ]

A). $F_X(x)$ B) $F_Y(y)$ C).$F_Y(y)$ $F_X(x)$ D).none

39. If X and Y are uncorrelated then Rxy=_____ [ ]

A)1 B).0 C)∞ D) none

40. σ_{xy} is known as_____ [ ]

A). mean B). Correlation C). Covariance D) variance

UNIT-III
RANDOM PROCESS- TEMPORAL CHARACTERISTICS

1. The collection of all the sample functions is referred to as [ ]

A)Ensemble B). Assemble C).Moment D).Set

2.If the future values of the sample function cannot be predicted based on its past values, the Process is referred as [ ]

A.Deterministic process B).Non- deterministic process C).Both D).None

3. If the future values of the sample function can be predicted based on its past values, the Process is Referred as [ ]

A).Deterministic process B).Non- deterministic process C).Both D).None

4. For an ergodic process [ ]

A).Mean is necessarily zero B).Mean square value is independent of time C).Both D).None

5. A Stationary random process X(t) is periodic with period 2T.Its autocorrelation function is [ ]

A).Non periodic B)Periodic with period T C). Periodic with period T D).None

6.The difference of two independent poison processes is [ ]

A).Poisson process B).Not a Poisson process C).Mean D).None

7.The $R_{XY}=0$, then X and Y are [GATE:2006] [ ]

A).Independent B).Orthogonal C).Both D).None

8.The mean of a random process X(t) is the expected value of the random variable X at time t ie..the Mean m(t)= [ ]

A). $\int_{-\infty}^{\infty} f$x(x,t)dx B). $\int_{-\infty}^{\infty} xf$x(x,t)dx C). $\int_{-\infty}^{\infty} f$x(x,t)da D).None

9.If a process is stationary to all orders n=1,2,3…..N,then Xi=X(t i),where i=1,2,3,……N [ ]

A).Strict sense stationary B).Wide sense stationary C).Both D).None

10. A random process is said to be stationary if all statistical properties does not change with [ ]

A).Time B).Frequency C).Amplitude D).None

11.Time average of $X^2(t)$ is called …….mean value of x(t) [ ]

A).Time B).Average C).Power D).None

12.The random process that satisfies the …….theorem are called ergodic process [ ]

A).Superposition B).Ergodic C).Duality D).None

13.The autocorrelation function of a Poisson process $R_{xx}(t_1,t_2)$ for t1>t2 is [ ]

A). $\lambda t_2(1+\lambda t_1)$ B). $\lambda(t)$ C).1 D). 0

14.The autocorrelation function of X(T) , $R_{XX}(\tau)$ is [ ]

A).$E[X^2(t)]$ B).E[X(t)] C).$E[X(t)X(t+\tau)]$ D).None

15. $R_{XX}(\tau)$ is an even function of τ ie.. [ ]

A).$R_{XX}(-\tau) = R_{XX}(\tau)$ B) .$R_{Xx}(0) = R_{XX}(\tau)$ C). $R_{XX}(0) = R_{XX}(-\tau)$ D).None

16.If X(t) is periodic,then its autocorrelation function is also [ ]

A). Periodic B).A periodic C).Continuous D).None

17. The ……..function of a random process $R_{XX}(\tau)$ cannot have any arbitrary shape [ ]

A)Autocorrelation B).Cross correlation C).Variance D). Covariance

18 .If X(t) and Y(t) are two random process with autocorrelation function $R_{XX}(\tau)$ and $R_{yy}(\tau)$,then the cross Correlation Function satisfies the inequality [ ]

A)Equality B). Inequality C).Both D).None

19. $R_{XY}(\tau) = R_{YX}(-\tau)$ is a [ ]

A) Asymmetry property B). Symmetry property C).Both D).None

20.The Poisson process X(t) is a ……..random process [ ]

A).Continuous B).Discrete C).Mixed D).None

21. The family of sample functions over the sample space S is called [ ]

A).Ensemble B) Matrix C). Empty set D).None

22. A random process is said to be ……if both the random variable X and time are continuous over the entire time [ ]

A) Continuous B).Discrete C).Mixed D) .None

23. A random process is function of _____ & _____ [ ]

A). Time B). Sample space C) Both D). None

24. The first order distribution function of random process Fx(x1,t1)=_____ [ ]
A). P(X<x) B). P(X1<t1) C). P(X (t1) ≤x1) D). none

25. For Strict sense stationary random process the ____ order density function independent of t [ ]
A)First B) Second C).Third D). n^{th}

26. For a continuous random process time t is_____ [ ]
A) continuous B).discrete C). either a or b D). none

27. The mean square value of a random process X(t) is_____ [ ]
A). E[X(t)] B). $E[X^2(t)]$ C).E[X(t)Y(t)] D). E[X(t1)X(t2)]

28. The random process is also known as _____ process [ ]
A).stochastic B). non deterministic C). both a b D). none

29. For a first order stationary random process E[X(t)] is_____ [ ]
A). constant B) function of X C)function of t D). none

30. The auto correlation function Rxx(t,t+τ)=_____ [ ]
(GATE 2016)
A). E[X(t)X(τ)] B). E[X(t)X(t+τ)] C). E[X(t)Y(τ)] D). E[X(t1)X(τ)]

31.For auto correlation ergodic random process statistical autocorrelation is=___ [ ]
A). time mean B). time autocorrelation C). Statistical mean D). cross correlation

32. The average power of a random process is autocorrelation function at τ=___ [ ]
A)1 B)10 C)0 D)0.1

33. The time average of _____ moment is known as average power [ ]
A) 1st B) 2nd C) 3rd D) n^{th}

34. In a Gaussian random process [Cx] represents _____matrix of X(t) [ ]
A). mean B) Variance C) Covariance D). none

35. In a random process X(t), x(t) represents _____ [ ]
A) random variable B) Gaussian variable C).sample function D). none

36. The second order density function of a random process is __derivative of Fx(x1,x2:t1,t2). [ ]
A)2nd B) 3^{rd} C). n^{th} D). 1^{st}

37. For a WSS stationary random process Rxx(t,t+τ)=_____ [ ]
A).Rxx(t) B)Rxx(τ) C) Rxy(t,t+τ) D) Ryx(t,t+τ)

38. For a discrete random sequence time t is_____ [ ]
A) continuous B) discrete C). either a or b D). none

39. The cross correlation of X(t) and Y(t)=_____ [ ]
A). E[X(t,t+τ)] B). $E[X^2(t)]$ C).E[X(t)Y(t)] D). E[X(t1)X(t2)]

40. The auto correlation function Rxx(τ)=_____ [ ]
(GATE 2013)
A). Ryx(-τ) B). Ryx(τ) C). Rxy(τ) D). Rxx(-τ)

UNIT-IV

RANDOM PROCESS-SPECTRAL CHARACTERISTICS

1. PSD means [ ]
A).power system density B)power spectral distribution C).power spectral density D). none

2.The power spectral density of a wide sense stationary is always [ ]
A).Non negative B).negative C).both D).none

3.Spectral characteristics means random process in ---------- domain [ ]
A).time B).frequency C).correlation D).system
4.For a periodic signals---------- is used for the study of spectral behavior [ ]
A).Fourier series B).Fourier transform C).Z-Transform D). Laplace transform
5.For a Non-periodic signals ---------- is used for the study of spectral behavior [ ]
A).Fourier series B).Fourier transform C).Z-Transform D).Laplace transform
6.Sxy(ω)=0,if X(t) and Y(t) are---------- [ ]
A).orthogonal B).vertical C).parallel D).none
7.Fourier transform belongs to ---------- domain [GATE:2005] [ ]
A).time .B).frequency C).correlation D).system
8.Sxx(-ω)= [ ]
A).Sxx(ω) B).-Sxx(ω) C).-Sxx(-ω) D).none
9.power spectral density and autocorrelation are ----------pair [ ]
A).fourier transform B).Z-Transform C).Laplace transform D).none
10.the power density spectrumof a real process X(t) is an ----------function [ ]
A).even B).odd C).time D).frequency
11.Sxy(ω)= [ ]
A).Sxy(ω) B).-Sxy(-ω) C).Syx(-ω) D).Sxy(-ω)
12.if X(t) and Y(t) are Orthogonal then [ ]
A).Sxy(ω)=0 B).Sxy(ω)=1 C).Sxy(ω)≥2 D).Sxy(ω)≤2
13. Sxy(w)=0 and Syx(w)=0 if if X(t) and Y(t) are ---------- [ ]
A).orthogonal B).independent C).dependent D).none
14. The cross power P_{XY} [ ]
A)P^*_{YX} B).$-P^*_{YX}$ C). $-P^*_{xy}$ D).none
15.The output power density of Y(t) can be obtained by,$S_{yy}(\omega)$= [ ]
A).$IH(\omega)I^2S_{xx}(\omega)$ B). $R_{XX}(\tau)$ C). $R_{XX}(-\tau)$ D).none
16.If X(t) and Y(t) are orthogonal,then [ ]
A). $\int_{-\infty}^{\infty} S_{XY}(\omega)=0$ B). $\int_{-\infty}^{\infty} S_{XY}(\omega)=1$ C). $\int_{-\infty}^{\infty} S_{XY}(\omega)> 0$ D). $\int_{-\infty}^{\infty} S_{XY}(\omega)<0$
17.The cross spectral density $S_{YX}(\omega)$ [ ]
A). $S_{XY}(\omega)$ B). $S_{XY}(-\omega)$ C).1 D).none
18.Power density spectrum is _____transform of autocorrelation function [ ]
A)Z B). Laplace C).Fourier D). none
19.$X_T(\omega)$ is Fourier transform of _____ [ ]
A). X(ω) B). X(t) C). E[X(t)] D). cross correlation
20.Sxy(-ω)=_____ [ ]
A) 0 B). S*yx(ω) C). Syx(-ω) D). 1
21.Syy(ω) is= _____ [ ]
A).Sxy(ω)H(ω) B). Syx(ω)H*(ω) C). Syx(ω)H(ω) D). Syy(ω)H(ω)
22.If X(t) and Y(t) are uncorrelated then Sxy(ω)= [ ]
A) 1 B).∞ C) 0 D). none
23.The power density spectrum and autocorrelation function are [ ]
A).Fourier transform pairs B).Z-Transform pairs C).Laplace transform pairs D).none
24.$S_{XX}(\omega) \geq$ [ ]
A). 0 B).1 C).2 D).4
25.The power density function at zero frequency is equal to the area under the curve of the_____ [ ]
A). Autocorrellation B). Crosscorellation C). Both D).None
26. Power density spectrum of a real process X(t) is an _____ function [ ]
A).Even B). Odd C). Real D).None
27. $S_{XX}(\omega)$ is always a _____function. [ ]
A).Even B).Odd C).Real D).None

28. The time average of the mean square value of a WSS random process equals the area under the curve of the _____ [ ]
A) power system density B)power spectral distribution C)power spectral density D) none
29. The power density spectrum and the time average of the autocorrelation function form a _____[ ]
A).Fourier transform pairs B).Z-Transform pairs C).Laplace transform pairs D).none
30.$S_{XX}(-\omega)=S_{XX}(\omega)$ is a_____ function [ ]
A.Even B.Odd C).Real D).None
31. The cross PSD and cross correlation function are [ ]
A) Even B)Odd C).Real D). None
33. The imaginary part of $S_{XY}(\omega)$ and the imaginary part of $S_{YX}(\omega)$ are_____ function [ ]
A). Even B). Odd C). Real D). None
34. Time average of the cross correlation function and cross power spectral density are_____ [ ]
A). Fourier transform pairs B).Z-Transform pairs C). Laplace transform pairs D). none
35. The power spectral density of WSS is always [ ]
A) Negative B). Non negative C). Finete D). None
36. The average power P_{XY} [ ]
A).P^{*}_{YX} B).P_{XY} C).$-P^{*}_{xy}$ D).None
37. ACF means [ ]
A). Autocorrelation function B). Auto center function C). Autocummulative function D).None
38.The average power P_{xx} of a WSS random process X(t) is defined as the ____of its second moment[ ]
A). Time average B). Frequency C). Time period D)None
39.$R_{XX}(\tau)$ and $S_{XX}(\tau)$ are a [ ]
(GATE 2010)
A).Fourier transform pairs B).Z-Transform pairs C).Laplace transform pairs D).none
40.$S_{XY}(\omega)=0$ and $S_{YX}(\omega)=0$ if X(t) and Y(t) are [ ]
(GATE 2015)
A).Orthogonal B).Perpendicular C).Parallel D).None

UNIT –V
LINEAR SYSTEMS WITH RANDOM INPUTS

1. White noise with two sided PSD n/2 is passed through an RC-low pass network with time constant T= R.C
and there after though an ideal amplifier with voltage gain 10. The expression for mean square value of output noise is _____ [ ]

A). $\frac{\eta}{RC}$ B). $\frac{\eta}{25RC}$ C). $\frac{25\eta}{RC}$ D). $\frac{RC}{\eta}$

2. A random process X(t) has $R_{XX}(\tau) = A^2 + B.e^{-|\tau|}$, where A and B are+ve constant The mean value of the

response of a system Having an impulse response $h(t) = e^{-kt}$ for $t > 0$ [ ]
$= 0$ for $t< 0$
Where K is a real positive const, for which X (t) is its input is
A). A/K B). AK C). AK^2 D) A.

3. X(t) is a WSS process with zero mean and is the input of an LTI system with $H(w) = \frac{1}{jw+2}$ .If

$R_{XX}(\tau) = e^{-2|\tau|}$, the area enclosed by the auto correlation function of output process is [ ]

A).1 B).1/2 C).1/16 D).1/4

4.If $R_{XX}(\tau) = 3.\delta(\tau)$ and $H(w) = \frac{1}{6 + jw}$ then the mean smale value of Y(t) is [ ]

A).3 B).4 C).1/3 D).1/4

5. A system is said to be linear system if the system satisfies [ ]

A). principle of superposition B). principle of homogeneity C)Both A&B D) Reciprocity principle

6. For an LTI system, the response y(t) , for any input x(t), with the known impulse response can be determined using _____ integral [ ]

A). convolution B). Fourier & Laplace C). fourier D). laplace

7. The cross correlation between X(t) and Y(t) is the $R_{XY}(\tau)$ = [ ]

A). $h(\tau) * R_{XX}(\tau)$ B). $h(-\tau) * R_{XX}(\tau)$ C). $h(-\tau) * R_{XY}(\tau)$ D). $h(\tau) * R_{YX}(\tau)$

8. A random process X(t) of mean 3 is applied to a delay element. The mean of the o/p process is [ ]

A).2 B).3 C).1.5 D).9

9. A Process is said to be narrow band if the frequency band width W is____frequency near band Center [ ]

A).equal to the B).much greater than C).much lesser than D).none

10) If the input power spectral density of a $S_{XX}(w) = N_0\left[\frac{w^2 + 9}{w^2 + 16}\right]$ [ ]
system is and its output PSD is $S_{YY}(w)$ N0. then the transfer function of the system is

A). $\frac{w - j3}{w - j4}$ B). $\frac{w + j3}{w + j4}$ C). $\frac{w + j4}{w + j3}$ D). $\frac{w - j4}{w - j3}$

11.For a LTI system its impulse response and transfer function form a pair of [ ]

A).convolution B).Fourier transform C).both D).none

12) If $S_{XX}(w)$ is the power spectrum of the input process X(t) and $|H(w)|^2$ is [ ]
the power transfer function of the system then the average power P_{YY} is=

A) $\int_{-\infty}^{\infty} S_{XX}(w)|H(w)|^2 dw$ B). $\frac{1}{2\pi}\int_{-\infty}^{\infty} S_{XX}(w)|H(w)|^2 dw$

C). $\int_{-\infty}^{\infty} \frac{S_{XX}(w)}{|H(w)|^2} dw$ D). $\frac{1}{2\pi}\int_{-\infty}^{\infty} \frac{S_{XX}(w)}{|H(w)|^2} dw$

13) The output power spectral density of Y(t) can be obtained by the formula $S_{YY}(w)$ = [ ]

A). $\frac{S_{XX}(w)}{|H(w)|}$ B). $\frac{S_{XX}(w)}{|H(w)|^2}$ C). $|H(w)|S_{XX}(w)$ D). $|H(w)|^2 S_{XX}(w)$

14)If N(t) is WSS, then X(t) and Y(t) are [ ]
A). Jointly WSS B).WSS C).Gaussian D).Poisson

15) If the power density spectrum $S_{NN}(w)$ of a random process has its significant components clustered in a B.W W(rad/s) that does not include w = 0. Then it is _____ process. [ ]
A). band limited B). band pass C). narrow band D). stationary

16) For an LTI system, its impulse response and transfer function form a _____ pair. [ ]
A). Laplace transform B). Fourier transform C). Z-transform D) convolute on

17) If the power spectrum of a band pass random process is zero outside some frequency band of width W(rad/s) that does not include w = 0, the process is called [ ]
A). band limited B). band pass C). narrow band D). stationary

18) A process is said be narrow band if the frequency band of width w is _____ [ ]
frequency near band-center.
A). equal B). much greater C). much smaller D). twice

19) The RMS noise voltage across a 2μF capacitor over the entire frequency band when the capacitor is shunted by a 2KΩ resistor maintained at 300^0K is [ ]
A). 0.454Mv B). 4.54Mv C). 454μV D). 0.0454Mv

20) When noise is mixed with a sinusoid the amplitude and PSD of the resulting noise component becomes &
of the original respectively [ ]
A). Same as that of original B). Half, half C). half, one-third D). half, one-fourth

21) The available noise power per unit bandwidth at the input of an antenna with a noise temperature of 15^0K,
feeding into a microwave amplifier with Te = 20^0K is [ ]

A). 483 x 10^{-23}w B). 4.83 x 10^{-23}w C).48.3 x 10^{-23}w D). 483w

22) Let n(t) be the narrow band representation of noise where $n(t) = n_c(t)\cos w_c t - n_s(t)\sin w_c t$, and let P_1, P_2, P_3 are powers of n(t), $n_c(t)$ and $n_s(t)$ respectively then [ ]

A). $P_1 = 2P_2 = 3P_3$ B). $P_1 = \frac{P_2}{2} = \frac{P_3}{3}$ C). $P_1 = P_2 = P_3$ D).$3P_1 = 2P_2 = P_3$

23) The equivalent noise temperature of parallel combination of two resistors $R_1 = R_2 =$ Roperating at noise temperature T_1, and T_2 respectively is [ ]

A). $T_1 + T_2$ B). $(T_1 + T_2)^2$ C). $\frac{T_1 + T_2}{2}$ D). $T_1 . T_2$

24) In defining the noise bandwidth of a real system, it is required that the noise power N_1 passed by ideal filter and noise powder N_2 passed by real filter should be related as [ ]

A). $N_1 = 2N_2$ B). $N_2 = 2N_1$ C). $N_1 + N_2 = 1$ D). $N_1 = N_2$

25)Two resistor with resistances R_1 and R_2 are connected in parallel and have physical temperatures T_1 and T_2 respectively If $T_1 = T_2 = T_1$, what is T_s ? [ ]

A). T B). T/2 C). T/3 D). T/4

26) An amplifier has three stages for which Te1 = 1500K (first stage), Te2 = 3500K and Te3 = 6000K (output stage). Available power gain of the first stage is 10 and overall input effective noise temperature is 1900K then the available power gain of second stage and cascade's noise figure are respectively[ ]

A). 12, 1.655 B). 1.655, 12 C). 14,3.65 D). 3.65, 14

27) In an amplifier, the first stage in a cascade of 5 stages has $T_{e1} = 75^0K$ and $G_1 = 0.5$. Each succeeding stage has an effective input noise temperature and an available power gain that are each 1.75 times that of the stage preceding it. The cascade's effective input noise temperature is [ ]

A). 50.26^0K B). 500.26^0K C). 400.26^0K D). 550.26^0K

28) The total available output noise power spectral density for a noisy two port network is G_{a0} = [ ]

A). $g_a(f)(T_0 + T_e)$ B). $g_a(f)\,k.(T_e + T_0)$ C). $g_a(f).\frac{K}{2}(T_e + T_0)$ D). $g_a(f)\,k.(T_e + T_0)$

29) The noise present at the input of a two port network is 1μw. The noise figure of the network is 0.5dB and its gain is 10^{10}. The available noise power contributed by two port is [ ]

A). 1.22KW B). 12.2KW C). 122 KW D). 1220 KW

30) If $g_a(f)$ is the available gain of the network these the noise figure in terms of (effective noise temperature) and T_0 is [ ]

A). $\frac{T_e}{T_0}$ B). $1+\frac{T_e}{T_0}$ C). $\frac{T_0}{T_e}$ D). $1+\frac{T_0}{T_e}$

31) The equivalent noise temperature of an amplifier with noise figure of 0.2dB at a temperature of 290^0K is [ ]

A). 13.6^0K B). 15^0K C). 20^0K D). 14.8^0K

32) If cascading of 2 two port networks is done, then the corresponding equivalent (effective) noise temperature of the cascade is obtained as T_e= Where T_{e1} and T_{e2} are effective noise temperatures of two part - 1 & two port - 2 respectively. is available gain of port – 1 [ ]

A). $T_{e_1} + T_{e_2}$ B). $Te_1 + \frac{Te_2}{g_{a_1}}$ C). $T_{e_2} + g_{a_1} T_{e_1}$ D). $Te_2 + \frac{Te_1}{g_{a_1}}$

33) If Z(t) = X(t) + Y(t) where X(t) and Y(t) are two WSS processes and X(t) and Y(t) are uncorrelated and of zero then $R_{ZZ}(\boldsymbol{\tau})$= [ ]

A). $R_{XY}(\tau) + R_{YX}(\tau)$ B). B) $R_{XX}(\boldsymbol{\tau}) + R_{YY}(\boldsymbol{\tau})$ C). $R_{XY}(\tau) - R_{YX}(\tau)$ D). $R_{XX}(\tau) + R_{YY}(\tau)$

34) The mean square value for the Poisson process sX(t) with parameter $\boldsymbol{\lambda}t$ is [ ]

A). λt B). $(\lambda t)^2$ C).$\boldsymbol{\lambda}t + (\boldsymbol{\lambda}t)^2$ D). $\lambda t - (\lambda t)$

35) The interval between two consecutive occurrences of Poisson process is ____r.v. [ ]

A). guassian B). poission C). binomial D). exponential

36) The random process X(t) and Y(t) are having their auto correlation functions as and respectively. If they

are orthogonal processes, then the mean square value of X(t) + Y(t) is [ ]

A).2 B).3 C).4 D).6

37) X and Y and Z are uncorrelated R.V's with the semi variance. Find the correlation coefficient between (X + Y) and (Y + Z). [ ]

A)0. B).1/2 C).1/4 D).1

38) The independent R.V's with zero mean are [ ]

A). orthogonal B). Non-orthogonal C).correllated D).none

39) Which of the following is correct [ ]

A). $\rho > 1$ B) . $-\infty < \rho < \infty$ C). $0 \le \rho \le 1$ D). $-1 \le \rho \le 1$

40) X and Y are two independent normal r.v'sN(m, $\boldsymbol{\sigma}^2$) = N(0, 4). Consider V = 2X + 3Y is a _ R.V .[ ]

A).Rayleigh B).guassian C).binomial D).poission