Subject Name: PROBABILITY THEORY AND STOCHASTIC PROCESSE

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Year and Sem, Department: II Year I Sem ECE Dept.

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

1. $P(A)+P(\bar{A})=1$. Or $P(\bar{A})=1-P(A)$
2. Since $A \cup \bar{A} = S$, $P(A \cup \bar{A})=1$
3. The probability of the impossible event is 0, i.e $P(\emptyset)=0$
4. If $A \subset B$, then $P(A) \le P(B)$.
5. If A and B are two incompatible events, and therefore, $P(A-B)=P(A)-P(A\cap B)$.and $P(B-A)=P(B)-P(A\cap B)$.
6. $P(B/A)=\dfrac{P(A\cap B)}{P(A)},\ \ P(A)\neq 0$
7. $P(A\cap B)=P(A)P(B/A)=P(B)P(A/B)$
8. $P(A\cap B)=P(A)P(B)$
9. $F(x)=P(X\le x)$
10. $f(x)=\dfrac{d}{dx}F(x)$
11. $P_X(k)=(e^{-\lambda}\lambda^k)/k!$
12. $p_X(k)={}^nC_k p^k(1-p)^{n-k}\quad k=0,1,\ldots,n$
13. $f_X(x)=\dfrac{1}{\sqrt{2\pi}\sigma_X}e^{-\frac{1}{2}\left(\frac{x-\mu_X}{\sigma_X}\right)^2}$, $\quad f_X(x)=\dfrac{1}{\sqrt{2\pi}}e^{-\frac{1}{2}x^2}$
14. $F_X(x/B)=P[\{X\le x\}/B] = \dfrac{P[\{X\le x\}\cap B]}{P(B)}\quad P(B)\neq 0$

15. $$f_X(x/B) = \frac{d}{dx}F_X(x/B)$$

Short Questions (minimum 10 previous JNTUH Questions – Year to be mentioned)

Unit-I: Probability & Random Variable

SHORT ANSWER QUESTIONS:-

1. What are the Axioms of Probability? **[Dec- 2014],[Mar-2017]**
2. Explain the types of Random Variables. [**Dec-2014**]
3. What are the properties of Probability Distribution function? [**Dec-2014**]
4. Define a Random Variable. **[Nov-2015],[Mar-2017]**
5. State theorem of probability [**Mar-2017]**
6. Distinguish between Binomial and Poisson distribution. **[May-2017]**
7. Write the probability of Probability Density Function. **[Nov/Dec 2016]**
8.A discrete Random Variable can be defined on a continuous sample space. State whether it is true or false . Give an example to support your claim. **[Nov/Dec 2016]**
9. State the conditions for which two events are said to be independent. **[Nov/Dec 2016]**
10. Write two properties of Joint Distribution function of random variables. **[Mar 2017]**
11. Distinguish between Joint and condition probability **[Mar 2017]**
12. Discuss Exponential distribution **[Mar 2017]**
13. What is total probability and Baye's theorem **[Nov-2015]**
14. Explain probability density function with example **[Nov-2015]**
15. Mention the difference between continuous and mixed random variable **[Mar-2017]**
16. Write about the Rayleigh density and distribution function **[Mar-2017]**
17. Write the conditions for a function to be a random variable. [**Apr/May-2018]**
18. Explain the significance of mathematical model of experiments **[Apr/May-2018]**

LONG ANSWER QUESTIONS:-

1.State and prove baye's theorem of probability.**[Nov-2010][Dec-2011],[May-2011][Mar-2017]**

2.Let A1,A2,A3 are three mutually exclusive and exhaustive events associated with experiment E1.B1, B2,B3 are three mutually exclusive events associated with experiment with E2.

	B1	B2	B3	B4
A1	3/36	*	5/36	*
A2	5/36	4/36	5/36	14/36
A3	*	6/36	*	*
P(Bj)	12/36	14/36	*	*

i. Find missing probabilities
ii.P(B3/A1) and P(A1/B3)
iii.A1, B3 are independent or not? **[Mar-2017]**
3. The six sides of a fair die are numbered from 1 to 6.The die is rolled 4 times. How many sequences of the four resulting numbers are possible?
b.Define cumulative distribution function of a random variable.
c.State and prove axioms of probability. **[Mar-2017]**

4.In a hostel 60% of the students read Hindi newspaper and 40% read English newspaper and 20% read both Hindi and English newspapers . A student is selected at random
Find the probability that he reads neither Hindi nor English newspapers.
If he reads Hindi newspapers find the probability that he reads English newspaper. **[Mar-2017]**
5. Define the following and give example for each of the following
i. Discrete and continuous sample space ii. Mutually Exclusive event **[Mar-2017]**
6. Two cards are drawn from a desk of 52-cards deck (the first is not replace
i. given the first card is a queen , what is the probability that a second card is also queen ii.given the first card is a queen , what is the probability that a second card is 7 **[Mar-2017]**
7. Define and explain the following with an example
i. Mutually exclusive events ii Exhaustive evens iii. Equally likely events [**Nov-2015] [Mar-2017]**
8. A class Room contain 9 boys and 3 girls
   i. In how many ways can the teacher choose a committee of ‘4’?
   ii. How many of them will contain at least one girl?
   iii. How many of them will contain exactly one girl? **[Nov-2015]**
9. State the condition for a function to be a random Variable **[Nov-2015]**
10. In experiment where the pointer on a wheel of chance of paun. The possible outcomes are the numbers from 0 to 12 marked on the wheel. The sample space consists of the numbers in the set { $0< S\leq 12$} and if the random variable ‘X’ is defined as X = X(S) = ‘S’ map the elements of the random variable on the real line and explain .
[Nov-2015]
11. Write a short notes on i) Poisson distribution ii). Binominal distribution [**Nov -2015]**
12. Define probability, set and sample spaces **[Nov/Dec-2016]**
13. Discuss the relative frequency approach and axiomatic approach of probability.
14. In a box there are 100 resistors whose resistances and tolerances are as shown in the table below. Let A be the event of drawing a 47Ω resistor, B be the event of drawing a resistor with 5% tolerance, and C be the event of drawing a 100Ω resistor. Find P(A/B), P(A/C) and P(B/C).

	Tolerance		
Resistance (Ω)	5%	10%	Total
22	10	14	24
47	28	16	44
100	24	8	32
Total	62	38	100

15. Write the classical and axiomatic definitions of Probability and for a three digit decimal number chosen at random, find the probability that exactly K digits are greater than and equal to 5, for 0< K < 3

[Mar-2017]

16.A missile can be accidentally launched if two relays A and B both have failed. The probabilities of A and B failing are known to be 0.01 and 0.03, respectively. It is also known that B is more likely to fail (probability 0.06), if A has failed.

i.What is the probability of an accidental missile launch?

ii.What is the probability that A will fail, if B has failed?

iii.Are the events "A fails" and "B fails" statistically independent? **[Nov/Dec-2011]**.

17. Consider the experiment of tossing two dice simultaneously. If X denotes the sum of two faces, find the probability for $X \leq 6$.

i.A fair coin is tossed 4 times. Find the probability for the longest string of heads appearing to be three as a result of the above experiment.

18.In certain college, 25% of the boys and 10% of the girls are studying Mathematics. The girls constitute 60% of the student body. If a student is selected at random and studying mathematics, determine the probability that the student is a girl **[Nov/Dec-2011]**.

19. Coin A has a probability of head =1/4 and coin B is a fair coin. Each coin is flipped four times. If X is the number of heads resulting from coin and Y denotes the same from coin B, what is the probability for X=Y? [**Nov/Dec-2011]**.

20. A dice is thrown 6 times. Find the probability that a face 3 will occur at least two times.

21. Define probability, set and sample spaces **[Mar-2017]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The probality of any event bounded between **[ANS :0 and 1]**

2. A bag contains 3 red balls,4 white balls and 7 black balls.what is the probality of ball becomes red(or)black ball **ANS : 5/7]**

3. The probability of an event B,given as A event is p(B/A)**=[ANS: P(B∩A)/p(A) ,p(A)≠0**]

4. If two events are said to be mutually exclusive **then [ANS: A∩B=∅ ,p(A∩C)=0]**

5. If two events are occurring simultaneously then the two events are **[ANS: NOT MUTUALLY EXCLUSIVE]**

6. Let the favourable event be 'G' then how to calculate the proof of occurance of unfavourable Event **[ANS:P(G)=1-p(G)]**

7. Given event B a subset of event A then the P(A/B**)= [ANS :P(A/B)=1]**

8. Express the total probability by using conditional probability **[ANS :$\sum$P(A)=p(A/B_n).B_n]**

9. If A&B are two independent events , then the conditional probability[**ANS:p(A/B)=p(A),p(B/A)=p(B)]**

10. The probability density function (pdf) is defined by using probability distribution function**. [ANS:DERIVATIVE or fx(x)=dFx(x)/dx]**

11.When two dice thrown , find the probability of event A={sum =7} using axiom 3 **[A]**

a) 1/6 b) 2/36 c) 1/12 d) None

12. For any discrete random variable the cumulative distribution function plot is **a [B]**

a)unit step function b)stair case function c) a&b d)impulse function

13.f(x)=kx(1-x) in 0<x<1 the pdf of k= **[B]**

a) 4 b) 6 c) 7 d) 5

14.Gaussian density function plot in the form of **[D]**

a) Step b) Impulse c) Stair-case d) Ball shaped

15. The cumulative distribution function is defined **[A]**

a)Fx (x)=p{X<=x} b)Fx(x)=p{X>=x} c)Fx(x)=p{X=x} d)NONE

16.Fx(-∞/Y)=__________ and Fx(∞/Y)=________ **[B]**

a)0 and 0 b)0 and 1 c)1 and 0 d)1 and 1

17.If the mean of the Poisson variateX is one then P(X=1) **[C]**

a)e^{-2} b)e^{-3} c)e^{-1} d)e^{0}

18.skew is 20, variance is 16,the co-efficient of skew ness value **[A]**

a)4/16 b)5/16 c)6/16 d)7/16

19.if m_1 =2,E[x^2]=4,what is variance and standard derivation [**C]**

a)0&1 b)1&0 c)0&0 d)1&1

Unit-II: Operations On Single & Multiple Random Variables

Important points / Definitions: (Minimum 15 to 20 points covering complete topics in that unit)

1. $\sigma_X^2 = E(X-\mu_X)^2 = \int_{-\infty}^{\infty}(x-\mu_X)^2 f_X(x)dx$
2. $\sigma_X^2 = \sum_{i=1}^{N}(x_i-\mu_X)^2 p_X(x_i)$
3. $\phi_X(\omega) = Ee^{j\omega X} = \int_{-\infty}^{\infty} e^{j\omega x} f_X(x)dx$ where $j=\sqrt{-1}$
4. $f_X(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty}\phi_X(\omega)e^{-j\omega x}d\omega$

5. $F_{X,Y}(x,y) = P\{X \le x, Y \le y\}$

6. $f_{X,Y}(x,y) = \frac{\partial^2}{\partial x \partial y} F_{X,Y}(x,y)$

7. $f_{X,Y}(x,y) = f_X(x) f_Y(y)$

8. $\int \int_{-\infty}^{\infty} f_{X,Y}(x,y) dy dx = 1$

9. $\phi_{X,Y}(\omega_1, \omega_2) = \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} f_{X,Y}(x,y) e^{j\omega_1 x + j\omega_2 y} dy dx$

$$f_{X,Y}(x,y) = \frac{1}{4\pi^2} \int_{-\infty}^{\infty} \int_{-\infty}^{\infty} \phi_{X,Y}(\omega_1, \omega_2) e^{-j\omega_1 x - j\omega_2 y} d\omega_1 d\omega_2$$

SHORT ANSWER QUESTIONS:-

1. Define expected value of a random variable [**Nov-2015]**
2. Define Joint distribution function with example **[Nov-2015]**
3. Define Joint central Moment **[Nov-2015]**
4. Find the skew for Gaussian distributed random variable **[Mar- 2017]**
5. Distinguish deterministic and non-deterministic processes **[Mar-2017]**
6. Explain the covariance matrix and its properties **[Mar-2017]**
7. Mention the difference between the Variance and Skew**.** **[Mar-2017]**
8. Explain the equal and unequal distributions. **[Mar-2017**]
9. Write about linear transformations of Gaussian random variables. **[Mar-2017]**
10. Mention the properties covariance . **[Mar-2017]**
11. Write short notes on Chebychev's inequality. **[Apr/May-2018]**
12. Define Characteristic function and present generation of moments using it**. [Apr/May-2018]**
13 State central limit theorem for the case of equal distributions. **[Apr/May-2018]**
14. Write the properties of jointly Gaussian random variables **[Apr/May-2018]**

LONG ANSWER QUESTIONS:-

1.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 continues distribution function**.** **[Nov 2015]**

2. Discuss Moment generating function and its properties **[Nov 2015]**

3. Calculate E[X] when X is binomially distributed with parameters n and p **[Nov 2015]**

4. Discuss the probabilities of Joint density function for two random variables X and Y **[Nov-2015]**

5 A Joint probability density function is f(x,y) = 1/ab for 0< x < a, 0 < y< b and f(x,y) = 0 elsewhere. Find the joint probability distribution function. **Nov-2015]**

6. Prove that the mean value of a weighted sum of trandom varables equals the weighted sum of mean values. **[Nov 2015]**

7. Prove that if ‘ X’ ‘Y’ are two random variables taking real values then $\{E[XY)^2\} \leq E[X^2] . E[Y^2]$ **[Nov 2015]**

8. What do you mean by probability density function? state and drive its properties **[Mar-2017]**

9. Explain Rayleigh distribution and density functions **Mar-2017]**

10. Find moment generating function about the origin of the poission distribution **[Mar-2017]**

11. Determine the moment generating function of a random variable with density function fx (X) = $\frac{1}{b}\ e^{-(x-a)/b}$U(x) **[Mar-2017]**

12.Two cards are drawn simultaneously 9 or successively withput replacement0 from a well shuffled pack of 52 cards. Find the mean , variance and standard deviation of the number of kings **[Mar-2017]**

13. State central limit theorem for unequal distributions and explain **[Mar-2017]**

14.Two random variables X1 , X2 are related to Y as $Y = \sqrt{(X_1^2 + X_2^2)}$ .Find the probability density function of y in terms of joint density of X_1 , X_2 **[Mar-2017]**

15.Determine the constant b such that the function

$f_X(x)$ = 3xy : 0< x< 1 0< y<b

= 0 : other wise **[Mar-2017]**

16.Obtain the relationship between probability and probability density function. **[Mar-2017]**

17.Find the moment generating function of the random variable whose moments are mr = (r + 1)!2r. **[Mar-2017]**

18. Write about Chebychev’s inequality and mention about its characteristic function. **[Mar-2017]**

19. Determine the moment generating function about origin of the Poisson distribution **[Mar-2017]**

20. Differentiate between the marginal distribution functions, conditional distribution functions and densities.

[Mar-2017]

21.Given the transformation y= cos x where x be a uniformly distributed random variable in the interval (−π, π). Find fy (y) and E[y]. **[Mar-2017]**

22.Let X be a random variable defined, Find E [3X] and E[X2] given the density function as

$$f_x(x) = \begin{matrix} (\pi/16)\cos(\pi x/8), & -4 \leq x \leq 4 \\ 0, & elsewhere \end{matrix}$$

[Apr/May-2018]

23.Obtain the moment generating function of a uniformly distributed random variable. **[Apr/May-2018]**

24. Obtain the variance of Raleigh random variable. **[Apr/May-2018]**

25.A random variable X uniformly distributed in the interval $(0, \pi/2)$. Consider the transformation Y=sinx, obtain the pdf of Y. **[Apr/May-2018]**

26. Obtain the variance of Gaussian random variable **[Apr/May-2018]**

27.The joint characteristic function of two random variables is given by $\phi XY(\omega 1,\omega 2) = \exp(-\omega_1^2 - 4\omega_2^2)$. Check whether X and Y are uncorrelated or not. **[Apr/May-2018]**

28 X and Y are statistically independent random variables and W = X+Y obtain the pdf of W. **[Apr/May-2018]**

29. Write the properties of joint distribution function. **[Apr/May-2018]**

30.Prove that the variance of weighted sum of N random variables equals the weighted sum of all their covariance **[Apr/May-2018]**

31.Find the Moment generating function of a uniform random variable distribute over (A, B) and find its first and second moments about origin, from the Moment generating function. **[Nov/dec-2017]**

32.A random variable X has a mean of 10 and variance of 9. Find the lower bound on the probability of $(5<X<15)$ **[Nov/dec-2017]**

33.Find the Moment generating function of a random variable X with density function

$$f(x) = \begin{Bmatrix} x, \ for\ 0 \le x \le 1 \\ 2-x, \ for\ 1 \le x \le 2 \\ 0, \ else\ where \end{Bmatrix}$$

[Nov/dec-2017]

34.If X is a Gaussian random variable N(m, σ2), find the density of Y=PX+Q, where P and Q are constants **[Nov/dec-2017]**

35.If X1,X2,X3, - - - - - Xn are 'n' number of independent and Identically distributed random variables, such that Xk = 1 with a probability 1/2; = -1 with a probability 1/2. Find the Characteristic Function of the random VariableY=X1+X2+X3+ +Xn. **[Nov/dec-2017]**

36. If Independent Random Variables X and Y both of zero mean, have variance 20 and 8 respectively, find the correlation coefficient between the random Variables X+Y and X-Y. **[Nov/dec-2017]**

37.Let X=Cosθ and Y=Sinθ , be two random variables, where θ is also a uniform random variable over $(0,2\pi)$. Show that X and Y are uncorrelated and not independent. **[Nov/dec-2017]**

38. If X is a random variable with mean 3 and variance 2, verify that the random Variables 'X' and Y= -6X+22 are orthogonal **[Nov/dec-2017]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The probability distribution function Fx(x) of a random variable x then Fx(∞)= **[ans:1]**
2. By using _______ density function, the number of defective elements is calculated in a given sample space. **[Ans: POISSIONS]**

3. How to calculate normalized Gaussian distribution function if mean and variance are given. **[ANS: MEAN=0, VARIANCE=1]**
4. define uniform probability density if a &b are real constants. **[ANS: fx(x)=1/b-a ;a≤x≤b, 0;other wise]**
5.In Rayleigh probability density function when the maximum value is occurs________ **[ANS :dfx(x)/dx=0]**
6.If X is a discrete random variable and define the expected value of the random variable_______. **[ANS: E[X]=∑xi.p(xi)**
7.If a random variable X is a constant 'a' what is the expectation of 'a'_______. **[ANS: E[a]=a**]
8.Define nth order moment about origin_________.If the random variable is continuous. **[ANS:m_n =E[x^n] =∫x^n fx(x)dx]**
9.The firstcentral moment of 'X'is always equal to________.**[ANS: 0]**
10.The skew of the density function fx(x) for a random variable is defined as __________ moment. **[ANS :THIRD CENTRAL MOMENT]**

11 Variance of binomial distribution function is **[C]**
a)n b)np c)npq d)n^2 pq

12 The second moment about origin is called as **[A]**
a)mean squared value b) variance c) standard deviation d)mean value

13.E[a]=_____ where a is arbitrary constant **[C]**
a)0 b)1 c)a d)∞

14.It is a measure of a symmetry of the density function of a random variable about its mean [**A]**
a)skew b)skewness c) variance d)NONE

15. moments of a random variable are nothing but averages of____ **C]**
a)mean value b)mean square value c) statistical d)time

16. Variance [constant] value is **[D]**
a)-1 b)1 c) a&b d) 0

17. At what value of w the characteristics function becomes **maximum** **[C]**
a)1 b)-1 c)0 d) none

18. If E[x]=5/12 Find E[4x+2**]** **[B]**
a) 5/12 b)11/3 c)21/5 d)3/4

19.A coin is tossed 6times .find probability of getting 5 **heads** **[A]**
a)2/32 b)3/64 c)6/36 d)none

20.If fx(x) =1/6 for -3<x<3 & 0for other wise.Find P(x<1)= **[C]**
a)2/4 b)4/2 c)4/6 d)6/4

Unit-III: Random Processes – Temporal Characteristics
Important points

1. $F_{X(t)}(x) = P(X(t) \le x)$.
2. $f_{X(t)}(x) = \dfrac{dF_{X(t)}(x)}{dx}$.
3. $R_X(t_1,t_2) =$ *autocorrelation function* of the process at times $t_1, t_2 = E(X(t_1)X(t_2))$.
4. $\mu_X(t) =$ Mean of the random process at $t = E(X(t))$
5. $R_X(t,t) = EX^2(t) =$ second *moment or mean square value at* time t
6. $$C_X(t_1,t_2) = E(X(t_1) - \mu_X(t_1))(X(t_2) - \mu X(t_2)) = R_X(t_1,t_2) - \mu_X(t_1)\mu_X(t_2)$$
7. The ratio $\rho_X(t_1,t_2) = \dfrac{C_X(t_1,t_2)}{\sqrt{C_X(t_1,t_1)CX(t_2,t_2)}}$ is called the *correlation coefficient.*
8. *Cross − covariance function* of the processses at times t_1, t_2
$$C_{XY}(t_1,t_2) = E(X(t_1) - \mu_X(t_1))(Y(t_2) - \mu_Y(t_2)) = R_{XY}(t_1,t_2) - \mu_X(t_1)\mu_Y(t_2)$$

SHORT ANSWER QUESTIONS:-

1. Write about the following with examples i). discrete time stochastic process ii). Continuous time stochastic process **[Nov-2015]**
2. Discuss Gaussian random process and state its probability **[Apr/May-2018] [Nov-2015]**
3. Show that Sxx(ω) = Sxx(-ω). **[Nov/dec-2017]**
4. Explain WSS and SSS **[Nov-2010] [Apr/May-2018]**
5. Discuss about Mean and Correlation Ergodic process **[Nov-2010]**
6. Define autocorrelation function of a random process **[Apr/May-2018]**
7. Classify random processes and explain **[Apr/May 2018]**

LONG ANSWER QUESTIONS:

1. Explain the concept of random process and stationary process [**Mar-2017]**
2. Distinguish between Auto correlation function and cross correlation function. **[Mar-2017]**
3. State the properties of cross correlation function **[Mar-2017]**
4. Explain classification of randomproces with neat sketch **[Mar-2017]**
5. State and prove properties of cross correlation function. **[Mar-2017]**
6. If the PSD of X(t) is Sxx(ω). Find the PSD of dx(t)/dt. **[Mar-2017]**
7. A random process Y(t) = X(t)- X(t +τ) is defined in terms of a process X(t). That is at least wide sense stationary. a) Show that mean value of Y(t) is 0 even if X(t) has a non Zero mean

value. . **[Mar-2017]**

8. If Y(t) = X(t) +X(t + τ) find E[Y(t)] and σY2. **[Mar-2017]**

9. Write properties of auto correlation function of a WSS process and prove any three of them. **[Apr/May 2018]**

10 A random process X(t) = Acos(ωot) + B sin(ωot) where ωo is a constant and A, B are uncorrelated zero mean random variables with same variances. Check whether X(t) is WSS or not? **[Apr/May 2018]**

11.X(t) is a random process with mean =3 and Autocorrelation function Rxx(τ) =10.[exp(-0.3|τ|)+2]. Find the second central Moment of the random variable Y=X(3)-X(5). **[Apr/May 2018]**

12. X(t)=2ACos(Wct+2θ) is a random Process, where 'θ' is a uniform random variable, over (0,2π). Check the process for mean ergodicity. **[Apr/May 2018]**

13. A Random Process X(t)=A.Cos (2π fc t) , where A is a Gaussian Random Variable with zero mean and unity variance, is applied to an ideal integrator, that integrates with respect to 't', over (0,t). Check the output of the integrator for stationarity. **[Apr/May 2018]**

14. A random Process is defined as X(t)=3.Cos(2πt+Y), where Y is a random Variable with p(Y=0)=p(Y=π)=1/2.Find the mean and Variance of the Random Variable X(2) **[Apr/May 2018]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. In the random process X(s,t) if 's' and 't' are made fixed, then X(s),t) will be a ________. **(number)**

2. A random process is said to be stationary, if all its statistical properties do not change with _____. **(time).**

3. If a random process is said to be first- order stationary the$f_X(x_1,t_1+\tau)$= _____ **($f_X(x_1,t_1)$)**

4. If a R.P is solid to be first order stationary, then E[X(t)]=_______________ **(constant).**

5. For WSS process. $R_{XX}(t_1,t_1+\tau)$ = ______ **($R_{XX}(\tau)$)**

6.For an eragodic process______. (**time average of the process are equal to the essemble averages.)**

7.Mean value of athe random process in true sense**_____________.(** $\lim_{T\to\infty} \frac{\int_{-1}^{1} X(t)dt}{2T}$

8.________ averages are computed by considering all the sample functions. (**ensemble**)
9.All strict sense stationary (SSS) process are WSS, it is__________. (**true**)
10.For the R.P X(t)=$A\cos\omega t$ where $\omega$is a constant and A is uniform R.V over (0,1) , the mean square value is________ ($\frac{1}{3}\cos(\omega^2 t)$).
11.R$_{XX}$(0) = _______________ **E[x^2(t)]**
12.$R_{xx}(\tau)$ is an even function of________. (τ).
13,$|R_{xx}(\tau) \leq R_{xx}(0)$ it is________. **(true).**
14.If x(t) periodic with 2T, then it's ACF is __________. (**periodic with 2T**).
15.If a R.P has a DC component, its ACF function will also have DC component. It is **______.**
(true).
16.R$_{xy}$(τ) = _______________ **(R$_{xy}$(-τ))**
17.For jointly WSS process is C$_{XX}$(τ) = _______ **(R$_{XX}$(τ) – (x')^2)**
18.For jointly WSS process, C$_{XY}$(τ) = ______ **(R$_{XX}$(τ) –X'Y'**
19.$R_{xx}(a) - \overline{X^2}$=_____________. (**variance of X).**
20.If X(t) & Y(t) are uncorrelated then ________. **C$_{XY}$ (t,t+τ) = 0)**

21.The position R.P p[X(t).k] = (For an LTI system , system response Y(t)**_______.(X(t)** $\times h(t)$).
22. Mean va;ue of the system response **(Y(t)=**M_x **H(0)).**
23,Mean square value of the system response ________________ $\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} h(\tau_1).h(\tau_1).R_{xx}(\tau_1-\tau_2).d\tau_1\, d\tau_2$).)
24.Auto correlation function of the system response__________. ($\int_{-\infty}^{\infty}\int_{-\infty}^{\infty} h(\tau_1)\cdot h(\tau_2)\cdot R_{xx}(\tau-\tau_2)d\tau_1\cdot d\tau_2$).

Unit-IV:
SHORT ANSWER QUESTIONS:-

1. $S_X(\omega) = \int_{-\infty}^{\infty} R_X(\tau)e^{-j\omega\tau}d\tau$

2 $R_X(\tau) = \frac{1}{2\pi}\int_{-\infty}^{\infty} S_X(\omega)e^{j\omega\tau}d\omega$

the average power of a random process $X(t)$ is

3. $$EX^2(t) = R_X(0) = \frac{1}{2\pi}\int_{-\infty}^{\infty} S_X(\omega)dw$$

4. $$S_X(w) = \lim_{T\to\infty} \frac{E|X_T(\omega)|^2}{2T}$$

5. $$S_{XY}(\omega) = \int_{-\infty}^{\infty} R_{XY}(\tau)e^{-j\omega\tau}d\tau$$

6. $$S_{YX}(\omega) = \int_{-\infty}^{\infty} R_{YX}(\tau)e^{-j\omega\tau}d\tau$$

7. $$R_{XY}(\tau) = \int_{-\infty}^{\infty} S_{XY}(\omega)e^{j\omega\tau}d\omega$$

8. $$R_{YX}(\tau) = \int_{-\infty}^{\infty} S_{YX}(\omega)e^{j\omega\tau}d\omega$$

9. $$P_{XY} = \lim_{T\to\infty} \frac{1}{2T} E\int_{-T}^{T} X(t)Y(t)dt$$

10. $$P_{XY} = \frac{1}{2\pi}\int_{-\infty}^{\infty} S_{XY}(\omega)d\omega$$

11. $$H(\omega) = FT\,h(t) = \int_{-\infty}^{\infty} h(t)\, e^{-j\omega t}\, dt$$

12. $$S_Y(\omega) = S_X(\omega)H(\omega)H^*(\omega) = S_X(\omega)|H(\omega)|^2$$

13 $$R_{XY}(\tau) = h(-\tau) * R_X(\tau)$$ $$and\ R_{YX}(\tau) = h(\tau) * R_X(\tau)$$

14. $$S_{XY}(\omega) = H^*(\omega)S_X(\omega)$$ and $$S_{YX}(\omega) = H(\omega)S_X(\omega)$$

1. State wiener-khinchin relation. **[Nov 2017] [Mar-2017]**

2. Express the relationship between power spectrum and autocorrelation. **[Nov 2017]**
3. State any 2 properties of the power density spectrum? **[Nov 2017]**
4. Define cross power spectral density. **Mar-2017]**
5.State and explain the relation between power spectrum and Auto-correlation Function. **[Mar-2017]**
6. Check whether the function below is a valid power density spectrum or not

$$\frac{\omega}{j\omega^6 + \omega^2 + 3},$$

[Nov/Dec-2016]
7. Express the relationship between power spectrum and autocorrelation. **[Mar-2017]**
8. Autocorrelation function of a random process is given by Rxx(T)=3□(T). Find and sketch its power density spectrum. **[Nov/Dec-2016]**
9. Derive the relation between PSDs of input and output random process of an LTI system. **[Nov/Dec-2016]**
10. Define power spectrum **[Nov-2015]**
11. Discuss cross power density spectrum **[Nov-2015] [Mar–2017]**
12. Discuss the spectral characteristic of a system function **[Mar–2017]**
13. Write the expression for power spectral density. **[Apr/May 2018]**
14. Write any three properties of cross-power density spectrum **[Apr/May 2018]**

LONG ANSWER QUESTIONS: -
1. Derive the expression for power density spectrum of a random process. **[Mar-2017]**
2. Write the properties of power spectral density. **[Mar-2017]**
3. Find the output PSD and output Auto correlation function for a system with h(t)= e^{-t} for t>0 as input with PSD $h_0/2$ **[Mar-2017]**
4. Derive the relation between inout and output ACF of an LTI system with impulse response h(t). **[Mar-2017]**
5. Derive the relationship between cross-power spectral density and cross correlation function of a random process. **[Nov/Dec-2016]**
6. Evaluate the cross power spectral densit given the cross correlation of two processes X(t) and Y(t) is (AB/2)[sinωt+cosω(2t+T)], where A. B and ω are constant. **[Nov/Dec 2016]**
7. Is power density spectrum an even function of 'ω' or odd function of 'ω'? Justify . **[Nov/Dec 2016]**
8. Prove Syy(ω)=|H (ω)^2|Sxx(ω). Where X(t) is input process of an LTI system and Y(t) its output. |H(ω)| is the transfer function of the LTI system. **[Nov/Dec 2016]**
9**.** Define cross power density spectrum and write its properties. **[Nov 2015],[Mar-2017]**
10. Explain any 4 Properties of Power Density Spectrum. **[Dec-2014] [Nov/Dec-2016]**
11. Drive the power density spectrum of output of a system, in terms of its input PSD. **[Dec-2014]**
12. Derive the relationship between Cross PSD & Cross Correlation Function. **[Dec-2014]**
13. The PSD of random process is given

Sxx(ω) =[π ,|w|<1
[0 , otherwise

Find its autocorrelation function. **[Dec-2014]**

14. Find and plot the auto correlation function of i)wide band White noise ii)band pass white noise **[Mar-2017]**

15, Derive the expression for the cross spectral density of the input process X(t) and the output process Y(t)of an LTI system interms of its transfer function **[Mar-2017]**

16. Compare and contrast auto and cross correlation

17. If Y(t) =Acos(w_0t+ Θ+N(t), where 'Θ' is a uniform random variable over (π,- π) and N(t) is a band limited Gaussian white noise process with PSD=K/2.If Θ and N(t) are independent, find the PSD of Y(t) **[Nov/Dec-2016]**

16. Derive the relationship between cross power spectrum and cross co relation function **[Nov/Dec-2016]**

17,The auto co relation function of a random process R_{XX}(T)=4cos(w_0T),where w_0 is a constant. Obtain its power spectral Density **[Nov/Dec-2016]**

18.Obtain the average power in random process X(t)=Acos(w_0t+ Θ)where A,w_0 are real constants and Θ is a random variable uniformly distributed in the range (0,2 π). **[Mar-2017]**

19. Discuss in detail about first order stationary process . **[Nov 2015]**

20. The auto correlation function of a random process X(t) is R_{XX} (τ) = 3 + s exp(-4τ). Find the PSD of X(t). **[Nov 2015]**

21 Find the PSD of a ranom process whose autocorrelation function is R_{XX}(τ) = A cos(w_0 τ) **[Nov 2015]**

22. A random process is defined as Y(t) = X(t) –X(t-a) where S(t) is WSS process and a>0 is a constant. Find PsD of Y(t) in terms of the corresponding quantities of X(t). **[Nov 2015]**

23. The auto correlation function of a random process X(t) is RXX (τ) = 3+2 exp (−4τ2).
a) Evaluate the power spectrum and average power of X(t).
b) Calculate the power in the frequency band −1/√2 < ω < 1/√2 **[Mar-2017]**

24. Derive the relation between PSDs of input and output random process of an LTI system **[Mar-2017]**

25. Derive the relationship between cross-power spectrum and cross-correlation function. **[Apr/May 2018]**

26.The autocorrelation function of a random process RXX(τ) = 4 cos(ωoτ), where ωo is a constant. Obtain its power spectral density. **[Apr/May 2018]**

27. Obtain the average power in the random process X(t) = Acos(ωot+□) where A, ωo are real constants and □ is a random variable uniformly distributed in the range (0, 2π**). [Apr/May 2018]**

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. Parsvel's theorem states that $(ans\colon \int_{-\infty}^{\infty} x^2(t)dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} |x(\omega)|^2\, dt.)$

2. Average power of a random process x(t) over (-T,T) is
   $(ans\colon P_{xx} = P_{av} = \lim_{n\to\infty} \frac{1}{2T}\int_{-T}^{T} E\,[X^2(T)].)$

3. The power spectral density is $(\text{ans: } S_{xx}(\omega) = \lim_{T\to\infty} \frac{E|[X_T(\omega)]^2|}{2T}.)$

4. Time average of auto correction function and PSD forms a(ans: fourier transform) pair.

5. $S_{xx}(\omega) = (ans\colon \int_{-T}^{T} R_{xx}(\tau)\cdot e^{-j\omega t} d\tau.)$

6. $R_{xx}(\tau) = (ans\colon \frac{1}{2\pi}\int_{-\infty}^{\infty} S_{xx}\,(\omega)\cdot e^{-j\omega t} d\omega.)$

7. For a W.S.S process, PSD at zero frequency gives _______ $\int_{-\infty}^{\infty} \mathbf{R_{XX}(\tau)d\tau}$

8. $\frac{1}{2\pi}\int_{-\infty}^{\infty} S_{xx}(\omega)\cdot d\omega =$ $(R_{xx}(0))$

9. $S_{xx}(\omega)$ is an (ans : <u>even)</u> function of frequency.

10. Fourier transform of $\delta(t)$ is equal to______ **(<u>1</u>.)**

11. The following which one is wiener-khintchine relation $(ans\colon R_{xx}(\tau) \leftrightarrow (F.S)S_{xx}(\omega).)$

12. Cross-power spectral density Sxx(w) = $\lim_{T\to\infty} \frac{E[XT(w).YT(w)]}{2T}$

13. Cross-power spectral density $S_{yx}(\omega) =$ $\lim_{T\to\infty} \frac{E[XT(w).YT(w)]}{2T}$

14. $S_{xy}(\omega) =$ (ans: both $S_{yx}(-\omega), S_{xy}(\omega)$.)

15. <u>(ans: Real</u>) parts of $S_{xy}(\omega)$ and $S_{yx}(\omega)$ are even functions of frequency 'ω'

16. (ans: Imaginary) part of $S_{xy}(\omega)$ and $S_{yx}(\omega)$ are odd functions of ' frequency ω'.

17. If x(t) and y(t) are uncorrelated and of constant means of E(x) and E(y) respectively, then SXY(w) = ____________ **(2π E(x).E(y).δ(w))**

18. CCF and C- PSD forms a (ans: fourier transform) pair.

19. Power spectral density of system response $S_{yy} = |H(\omega)|^2 \cdot S_{xx}(\omega)$.

20.$\{ans: S_{xy}(\omega)\} =H(\omega) \cdot S_{xx}(\omega)$

21.$S_{yx}(\omega) =$ ______________($ans: H(-\omega) \cdot S_{xx}(\omega)$.)

22. $S_{xx}(\omega) = \frac{\omega^2}{\omega^6+3\omega^2+3}$ is ________(ans: valid PSD.)

23. $S_{xx}(\omega) = \frac{\omega^2}{\omega^4+1} - \delta(\omega)$ is valid PSD. This statement is true.

24.A random process has the power density function $S_{xx}(\omega) = \frac{\omega^2}{1+\omega^2}$. The average power in the process is(ans: $\frac{1}{2}$)

25.The PSD of random process is $S_{xx}(\omega)\begin{cases} \pi\, ; |\omega| < 1 \\ 0; elsewhere \end{cases}$ the ACF is (ans: $\frac{\sin\tau}{\tau}$.)

Unit-V:
SHORT ANSWER QUESTIONS:-

LONG ANSWER QUESTIONS)

Fill in the Blanks / Choose the Best: (Minimum 10 to 15 with Answers)

1. The relation between PSD of flicker noise and frequency **s(w)** =**1/f**

2.The thermal noise is also known as **registor noise and johnson's noise**

3.Thermal noise is given by √**4RXTB watts**

4.Noise bandwidth BN = (1/|H(w0)|2) ∫0∞|H(w0)2| dw is **true**

5.Mean square value of thermal noise voltage is **4KTB**

6.Thermal noise is **gaussian** in nature

7.Generated voltage and currents is thermal noise are **independent of Frequency**

8.The PSD of thermal noise is **Si(w)=2KTG/(1-w/a)**

9.The constant PSD of white noise is **SNN(w)=N0/2**

10. Extraterrestrial noises are **solar noise and cosmic noise**

11. Available noise power in an electronic ckt is

12. For quadrature component of noise **E[nc(t).ns(t)]=0**

13. Effective noise temperature Te=**Te1+(Te2/8a1)**

14. Available noise power spectral density Gao=ga(f).k/**2**(T0+Te) is **true**

15. Total noise power available at the output of the two port network is

Nav=8a k(Ts+Te)BN