SRM INSTITUTE OF SCIENCE AND TECHNOLOGY

DEPARTMENT OF MATHEMATICS

18MAB203T – PROBABILITY AND STOCHASTIC PROCESSES

Course offered to B.Tech Nano III Sem and ECE IV Sem

Multiple Choice Questions

Module 1

1. A discrete random variable takes ______________ values

   (a) positive (b) finite (c) countably infinite (d) finite or countably infinite.

2. A continuous random variable takes _______________ values in an interval

   (a) positive (b) finite (c) countably infinite (d) entire

3. If X_1 and X_2 are random variables and k_1, k_2 are constants, then $k_1X_1 + k_2X_2$ is a

   (a) random variable (b) constant (c) not a random variable (d) random process.

4. If $F(x)$ is the cumulative distribution function of a random variable, $F(x)$ then is a ------- function

   (a) decreasing (b) probability density (c) constant (d) non decreasing

5. A random variable X takes 0, 1, 2, 3, 4 and its probability mass function is given by $P(X = x) = k(2x+1)$.The value of k is

   (a) $\frac{1}{2}$ (b) $\frac{1}{5}$ (c) $\frac{1}{10}$ (d) $\frac{1}{25}$

6. If the pdf of a random variable X is given by $f(x) = kx^2, -1 < x < 2$. Find k.

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

7. If the pdf of a RV X is $f(x) = 2x, 0 < x < 1$ then $P(X > 0.5)$ is equal to

   (a) $\frac{1}{2}$ (b) $\frac{2}{3}$ (c) $\frac{3}{4}$ (d) $\frac{4}{5}$

8. The RV X denotes the number that turns up when a die is thrown. The mean value of X is

   (a) $\frac{7}{2}$ (b) $\frac{3}{4}$ (c) $\frac{4}{5}$ (d) $\frac{-4}{5}$

9. The cumulative distribution function of a random variable X is $F(x)=1-(1+x)\exp(-x), x>0$. The probability density function of X is

(a) $f(x)=x\exp(-x), x>0$ (b) $f(x)=\exp(-x), x>0$

(c) $f(x)=\exp(x), x>0$ (d) $f(x)=x^2\exp(-x), x>0$

10. $Var(aX+b)$ is

(a) $a^2Var(X)$ (b) $aVar(X)$ (c) $aVar(X)+b$ (d) $a+b$

11. The mean and SD of a binomial distribution are 5 and 2. The value of n is

(a) 5 (b) 10 (c) 15 (d) 25

12. If an experiment has 50 trials and probability of success is 0.001 then the distribution used to calculate the probability is

(a) binomial (b) Poisson (c) normal (d) exponential

13. The mean of exponential distribution is 1/10. The variance of the distribution is given by
(a) 1/100 (b) 100 (c)1/10 (d) 10

14. The mean of the exponential distribution with parameter λ is

(a) $\frac{1}{2}$ (b) $\frac{1}{\lambda}$ (c) $\frac{\lambda}{2}$ (d) $\frac{\lambda^2}{2}$

15. Memoryless property is satisfied by

(a) binomial and Poisson distribution (b) Poisson distribution

(c) exponential distribution (d) exponential and normal distribution

16. The mean and variance of a standard normal variate is given by

(a) 0, 1 (b) 1, 0 (c) 1, 1 (d) 0, 0

17. If X is a continuous random variable then $P(X=a)$ is

(a) 0.5 (b) 0 (c) a (d) 1

18. If a and b are constants and X is a random variable, then $E(aX+b)$ is

(a) $aE(X)+b$ (b) $E(X)$ (c) b (d) $aE(X)$

19. If c is a constant, then

(a) $E(c)=1, Var(c)=1$ (b) $E(c)=1, Var(c)=0$

(c) $E(c)=c, Var(c)=0$ (d) $E(c)=c, Var(c)=c^2$

20. The first moment of X about its mean is always

(a) 1 (b) -1 (c) 0 (d) ± 1

21. If X is a Poisson variate such that $P(X=0)=0.6$, then Var(X) is

(a) $\ln(0.6)$ (b) 0 (c) $\ln\left(\frac{1}{0.6}\right)$ (d) 1

22. If X and Y are binomial random variables with parameters $\left(5,\frac{1}{2}\right)$ and $\left(6,\frac{1}{2}\right)$, then the parameters of the RV X + Y are

(a) $\left(11,\frac{1}{2}\right)$ (b) (11, 1) (c) (5, 1) (d) (6, 1)

23. If $\phi_X(\omega)$ is the characteristic function of a random variable X then the characteristic function of Y = aX + b is given by $\phi_Y(\omega)=$ __________ .

(a) $e^{i\omega b}\phi_X(a\omega)$ (b) $e^{-i\omega b}\phi_X(a\omega)$ (c) $e^{i\omega b}\phi_X(\omega)$ (d) $ae^{i\omega b}\phi_X(\omega)$

24. If $\phi_X(\omega)$ is the characteristic function of a random variable X then the characteristic function of $\phi_X(c\omega)=$ __________ .

(a) $c\phi_X(\omega)$ (b) $\phi_{cX}(\omega)$ (c) $c^2\phi_X(\omega)$ (d) $\phi_X(\omega)$

25. The CDF of a random variable X is defined as $F_X(x)=\begin{cases}1-\frac{100}{x}, & x>100\\ 0, & otherwise\end{cases}$. The pdf of f(x) is given by

(a) $\frac{100}{x^2}$ (b) $\frac{200}{x}$ (c) $\frac{200}{x^2}$ (d) $\frac{100}{x}$

26. The characteristic function has maximum value at $\omega=$ _________ .

(a) 0` (b) 1 (c) – 1 (d) 2

27. For real ω, $|\phi_X(\omega)|\le$ __________ .

(a) 0` (b) - 1 (c) 1 (d) 2

28. If X_1 and X_2 are two independent random variables then $\phi_{(X_1+X_2)}(\omega)=$ __________ .

(a) $\phi_{X_1}(\omega)+\phi_{X_2}(\omega)$ (b) $\phi_{X_1}(\omega)-\phi_{X_2}(\omega)$ (c) $\dfrac{\phi_{X_1}(\omega)}{\phi_{X_2}(\omega)}$ (d) $\phi_{X_1}(\omega).\phi_{X_2}(\omega)$

29. $F(\infty)=$ ________ where F(x) is the cumulative distribution function of X.

(a) 0` (b) 1 (c) – 1 (d) 2

30. $\sigma_X^2 =$ ____ .

(a) $E(X-c)^2$ (b) $E(X-\mu)^2$ (c) $E(X-0)^2$ (d) $E(X+\mu)^2$

Module2

1. If $p_{XY}(x,y)=k(x+y)$, for $0\le x\le 2, 0\le y\le 2$ where x and y are only integers then the value of k is

   (a) $\frac{1}{18}$ (b) $\frac{1}{12}$ (c) $\frac{3}{4}$ (d) $\frac{1}{3}$

2. For f(x,y) to be a joint pdf the conditions to be satisfied are

   (a) $f(x,y)\ge 0$ for all $x,y\in R$ and $\iint_R f(x,y)dxdy=1$

   (b) $f(x,y)\le 0$ for all $x,y\in R$ and $\iint_R f(x,y)dxdy=1$

   (c) $\iint_R f(x,y)dxdy=1$ (d) $f(x,y)\le 0$ and $\iint_R f(x,y)dxdy=0$

3. If F(x,y) is the CDF of a two dimensional continuous RV, then

   (a) $f(x,y)=\dfrac{\partial F}{\partial x}$ (b) $f(x,y)=\dfrac{\partial F}{\partial y}$ (c) $f(x,y)=\dfrac{\partial^2 F}{\partial x\partial y}$ (d) $f(x,y)=\iint F(x,y)dxdy$

4. Marginal probability function of X given the joint pdf $f(x,y)$ is

   (a) $\int f(x,y)dy$ (b) $\int f(x,y)dx$ (c) $\iint_R f(x,y)dxdy$ (d) $\dfrac{d}{dx}[f(x,y)]$

5. Two discrete random variables X and Y are independent if $p_{XY}(x,y)=$_____

   (a) $p_X(x)p_Y(y)$ (b) $p_X(x)$ (c) $p_Y(y)$ (d) $(p_X(x))^2$

6. If X and Y are independent RV's with density function $f_X(x)$ and $f_Y(y)$ respectively then the joint pdf $f_{XY}(x,y)$ is

(a) $f_X(x)+f_Y(y)$ (b) $f_X(x)-f_Y(y)$ (c) $\dfrac{f_X(x)}{f_Y(y)}$ (d) $f_X(x).f_Y(y)$

7. If $f_X(x)=e^{-x},\ x\geq 0$ & $f_Y(y)=e^{-y},\ y\geq 0$ where X and Y are independent RV's then the joint pdf of (X,Y) is

(a) $\dfrac{e^{-x}}{e^{-y}}$ (b) $e^{-x}+e^{-y}$ (c) $e^{-(x+y)}$ (d) $\dfrac{e^{-y}}{e^{-x}}$

8. If $x=uv$ and $y=u(1-v)$ then $J\left(\dfrac{x,y}{u,v}\right)$ is

(a) – u (b) 1 – u (c) uv (d) v

9. If $x=\dfrac{u}{v}$ and $y=v$ then $J\left(\dfrac{x,y}{u,v}\right)$ is

(a) $\dfrac{1}{u}$ (b) $\dfrac{1}{v}$ (c) v (d) uv

10. If (X,Y) is the joint distribution of two dimensional continuous RV then the joint distribution of (U,V) is given by

(a) $f(u,v)=f(x,y)\,|J|$ (b) $f(u,v)=f(x,y)+|J|$ (c) $f(u,v)=f(x,y)-|J|$

(d) $f(x,y)=f(u,v)\,|J|$ where $|J|=\dfrac{\partial(x,y)}{\partial(u,v)}$

11. For a 2 dimensional discrete RV, the joint pmf should satisfy the condition

(a) $p_{ij}\geq 0$ and $\sum_j\sum_i p_{ij}=1$ (b) $p_{ij}\leq 0$ and $\sum_j\sum_i p_{ij}=0$

(c) $p_{ij}\geq 0$ and $\sum_i p_{ij}=0$ (d) $p_{ij}\geq 0$ and $\sum_j p_{ij}=0$

12. If F(x,y) is the joint cumulative distribution function of (X, Y) then $F(\infty,\infty)=$

(a) 0 (b) ∞ (c) - ∞ (d) 1

13. The joint pdf of (X,Y) is $f(x,y)=\begin{cases}2x, & 0<x,y<2\\ 0, & otherwise\end{cases}$. Then the marginal pdf of X is

(a) 2(1 – x) (b) 2(1 – y) (c) 4x (d) 2yx

14. The joint pdf of (X,Y) is given by $f(x,y)=\begin{cases} x+1, & 0<x,y<1 \\ 0, & otherwise \end{cases}$. Then the value of $E(XY)$ is

(a) $\frac{1}{12}$ (b) $\frac{5}{12}$ (c) $\frac{1}{6}$ (d) $\frac{1}{3}$

15. If X and Y have joint pdf $f(x,y)=\begin{cases} x+y, & 0<x<1, 0<y<1 \\ 0, & otherwise \end{cases}$ then $f_X(x)$ is equal to

(a) $\frac{1+2x}{2}$ (b) $\frac{x+1}{2}$ (c) $\frac{x^2+2}{2}$ (d) $\frac{x^3+2x}{3}$

16. If p(x, y) is the joint pdf of (X, Y) then $p\left(\frac{y}{x}\right)=$ ___________

(a) $\frac{p(x,y)}{p_X(x)}$ (b) $\frac{p(x,y)}{p_Y(y)}$ (c) $\frac{p_X(x)}{p(x,y)}$ (d) $\frac{p_Y(y)}{p(x,y)}$

17. If $f_{XY}(x,y)$ is the joint pdf of (X, Y) then $f\left(\frac{x}{y}\right)=$ _____________

(a) $\frac{f(x,y)}{f_X(x)}$ (b) $\frac{f(x,y)}{f_Y(y)}$ (c) $\frac{f_X(x)}{f(x,y)}$ (d) $\frac{f_Y(y)}{f(x,y)}$

18. Two RV's X and Y are related by the equation Y = 3 – 3X. The value of Cov(X, Y) is

(a) 3 Var(X) (b) 9 Var(X) (c) – 3 Var(X) (d) – 9 Var(X)

19. Cov(aX, bY) = ____________

(a) $a^2b^2Cov(X,Y)$ (b) $abCov(X,Y)$ (c) $\frac{a}{b}Cov(X,Y)$ (d) $(a+b)Cov(X,Y)$

20. $F(-\infty, y)=$ _________ where F(x, y) is the cumulative distribution function.

(a) 1 (b) – 1 (c) 0 (d) $-\infty$

21. If $Var(X_1)=5, Var(X_2)=6, E(X_1)=E(X_2)=0, Cov(X_1,X_2)=4$, then $Var(2X_1-3X_2)$ is

(a) 20 (b) 26 (c) 25 (d) 24

22. Correlation coefficient r lies in the interval

(a) $0<r<1$ (b) $-1\le r\le 1$ (c) $-1\le r\le 2$ (d) $-1<r<0$

23. $Cor(X+Y, X-Y)=$

(a) $Var(X)+Var(Y)$ (b) $Var(X)-Var(Y)$

(c) $Var(X^2-Y^2)$ (d) $Var(X^2+Y^2)$

24. $F(x,-\infty)=$ ________ where F(x, y) is the CDF of (X, Y).

(a) 0 (b) 1 (c) – 1 (d) $-\infty$

Module 3

1. If $S_n \sim N(200,5)$ then $P(200 < S_n < 210)$ is equal to

(a) P(0 < z < 2) (b) P(- 2 < z < 2) (c) P(0 < z < 5) (d) P(- 2 < z < 1.6)

2. In Lindberg Levy's form $S_n = X_1 + X_2 + ... + X_n$ follows normal distribution with mean and S.D. equal to

(a) $n\mu, \sigma\sqrt{n}$ (b) $\mu, n\sigma$ (c) $\mu, \sigma/\sqrt{n}$ (d) $n\mu, n\sigma$

3. If mean = 1200 and S.D = 250 for each of n independent RV's with n = 60 then by CLT, $\bar{X}$ follows

(a) $N\left(1200, \frac{250}{\sqrt{60}}\right)$ (b) N(1200, 250) (c) $N\left(7200, \frac{250}{\sqrt{60}}\right)$ (d) $N(7200, 250\sqrt{60})$

4. --------- provides a simple method for computing approximate probabilities for sums of independent random variables.

(a) Central limit theorem (b) Tchebycheff's inequality (c) Jenson's inequality (d) Markov inequality.

5. If X is a random variable with mean 0 and finite variance σ^2 then for any $a>0$ $P\{X\ge a\}\le -----$

(a) $\frac{\sigma^2}{\sigma^2-a^2}$ (b) $\frac{\sigma}{\sigma^2+a^2}$ (c) $\frac{\sigma^2}{\sigma^2+a^2}$ (d) $\frac{\sigma}{\sigma^2-a^2}$

6. If X is a RV with $\mu_x = 3$ and $\sigma_x^2 = 16$ then the upper bound for $P(|X-3|\ge 3)$ is

(a) 16/9 (b) 11/3 (c) 7/3 (d) 19/25

7. The Markov inequality applies to a RV that takes only ------------------------

(a) Non negative values (b) negative values (c) discrete values (d) values defined in a range

8. Central limit theorem provides a simple method for computing approximate probabilities for sums of ---------- random variables.

(a) independent (b) dependent (c) correlated (d) uncorrelated

9. A RV X has a mean of 9 and a variance of 3. Then an upper bound for $P(|X-9|\geq 3)$ is

(a) 1/9 (b) 3 (c) 9 (d) 1/3

10. $P(X\geq a)\leq \dfrac{\sigma^2}{\sigma^2+a^2}, a>0$. The given inequality is

(a) Chebychev inequality (b) Jenson's inequality (c) Markov's inequality (d) One-sided Chebychev's inequality.

11. If $X_1, X_2, ...$ are independent and identically distributed RV's each having finite mean $E(X_i)=\mu$ then $E(\dfrac{X_1+X_2+....+X_n}{n})$ =-----------

(a) μ/n (b) μ (c) $n\mu$ (d) $\mu+n$

12. A RV X has mean 10 and variance 16. An upper bound of $P\{|X-10|\geq 5\}$ is

(a) 1/5 (b) 10/16 (c) 16/25 (d) 4/25

13. If $X_1, X_2, ...$ are independent and identically distributed RV's each having $Var(X_i)=\sigma^2$ then $Var(\dfrac{X_1+X_2+....+X_n}{n})=-----$

(a) $\dfrac{\sigma}{n}$ (b) $\dfrac{\sigma^2}{n}$ (c) $\dfrac{\sigma}{n^2}$ (d) $\dfrac{\sigma^2}{n^2}$

14. The Chernoff bound on $P(X\geq i)$ where X is a Poisson RV is

(a) $e^{\lambda(e^t-1)}e^{it}$ (b) $e^{\lambda(e^t+1)}e^{it}$ (c) $e^{-\lambda(e^t-1)}e^{it}$ (d) $e^{\lambda(e^t-1)}e^{-it}$

15. $P\{|X-\mu|\leq c\}\geq -----$ where $c>0$

(a) $1-\dfrac{\sigma}{c^2}$ (b) $1-\dfrac{\sigma^2}{c^2}$ (c) $1+\dfrac{\sigma^2}{c^2}$ (d) $1+\dfrac{\sigma}{c^2}$

Module 4

1. The set of possible values of any individual member of the random process is called

   (a) state space (b) sample function (c) number (d) single time function

2. Any individual member of the random process is called a

   sample function (b) member (c) number (d) single time function

3. If s is fixed, {X(s,t)} is a

   (a) single time function (b) number (c) time function (d) random variable

4. If t is fixed, {X(s,t)} is a

   (a) random variable (b) number (c) time function (d) single time function

5. If s and t are fixed, {X(s,t)} is a

   (a) number (b) random variable (c) time function (d) single time function

6. If both T and S are discrete, the random process is called a

   (a) discrete random sequence (b) continuous random sequence (c) discrete random process (d) continuous random process

7. If T is discrete and S is continuous, the random process is called a

   (a) discrete random sequence (b) continuous random sequence (c) discrete random process (d) continuous random process

8. If T is continuous and S is discrete, the random process is called a

   (a) discrete random sequence (b) continuous random sequence (c) discrete random process (d) continuous random process

9. If both T and S are continuous, the random process is called a

   (a) discrete random sequence (b) continuous random sequence (c) discrete random process (d) continuous random process

10. If certain probability distribution or averages do not depend on t, then the process{X(t)} is called

    (a) an evolutionary process (b) WSS process (c) stationary process (d) SSS process

11. If all the finite dimensional distributions of a random process are invariant under translation of time parameter then it is a

(a) an evolutionary process (b) SSS process (c) stationary process (d) WSS process

12. The first order densities of an SSS process are

(a) dependent on time (b) independent of time (c) continuous (d) discrete

13. The first and second order densities of an SSS process are

(a) dependent on time (b) independent of time (c) continuous (d) discrete

14. A random process that is not stationary in any sense is called

(a) Covariance stationary (b) SSS process (c) Ergodic process (d) an evolutionary process

15. Var{X(t)} is a function of t, the given process is

(a) WSS (b) SSS (c)a stationary process (d) an evolutionary process

16. In the fair coin experiment, we define the process {X(t)} as follows. $X(t) = \sin \pi t$, if head shows up and $X(t) = 2t$, if tail shows up. E{X(t)} is

(a) $\frac{1}{2}\sin \pi t + t$ (b) $-\frac{1}{2}\sin \pi t + t$ (c) $\frac{1}{2}\sin \pi t - t$ (d) $\frac{1}{2}\sin \pi t + 2t$

17. $R(\tau)$ is maximum at

(a) $\tau = -1$ (b) $\tau = 1$ (c) $\tau = 0$ (d) $\tau = 2$

18. If $\lim_{\tau \to \infty} R(\tau)$ exists, then the limit is equal to

(a) E[X(t)] (b) Var[X(t)] (c) E[X^2(t)] (d) $\{E[X(t)]\}^2$

19. $R_{XX}(0)$ is equal to

(a) E[X(t)] (b) Var[X(t)] (c) E[X^2(t)] (d) $\{E[X(t)]\}^2$

20. $R_{XX}(-\tau)$ is equal to

(a) $R_{XX}(\tau)$ (b) $-R_{XX}(\tau)$ (c) $\tau R_{XX}(\tau)$ (d) $-\tau R_{XX}(\tau)$

21. A stationary process has auto correlation function given by $R(\tau) = \frac{25\tau^2 + 36}{6.25\tau^2 + 4}$ then the mean value and variance of the process is respectively

(a) 4, 9 (b) 4, 6 (c) 6, 4 (d) 2, 5

22. A stationary process has ACF given $R(\tau) = 2 + 4e^{-2|\tau|}$, then the mean square value is

(a) 2 (b) 4 (c) 6 (d) 8

23. $R_{XY}(-\tau)$ is equal to

(a) $-R_{XY}(\tau)$ (b) $R_{XY}(\tau)$ (c) $R_{YX}(\tau)$ (d) $-R_{XY}(-\tau)$

24. Two random processes X(t) and Y(t) are ------------- if $R_{XY}(\tau)$ is zero

(a) dependent (b) independent (c) stationary (d) orthogonal

25. If the processes X(t) and Y(t) are independent then $R_{XY}(\tau) =$

(a) $E[X^2(t)].E[Y^2(t)]$ (b) $E[X(t)].E[Y(t)]$ (c) 0 (d) 1

26. $|R_{XY}(\tau)| \le$

(a) $\sqrt{R_{XX}(0)+R_{YY}(0)}$ (b) $\sqrt{R_{XX}(0)-R_{YY}(0)}$ (c) $\sqrt{R_{XX}(0).R_{YY}(0)}$

(d) $R_{XX}(0)+R_{YY}(0)$

27. If {X(t)} is a WSS process with $R_{XX}(\tau) = 4 + e^{-10|\tau|}$, then the mean of $S = \int_0^1 X(t)dt$ is

(a) 2 (b) 4 (c) 6 (d) 3

28. If the auto correlation function of a stationary process {X(t)} is given by $R_{XX}(\tau) = Ae^{-\alpha|\tau|}$, then the second order moment of the random variable X(8) – X(5) is

(a) $A(1-e^{-\alpha})$ (b) $A(1+e^{-\alpha})$ (c) $2A(1+e^{-3\alpha})$ (d) $2A(1-e^{-3\alpha})$

29. The variance of a random process who auto correlation function $R_{XX}(\tau) = 36 + \frac{4}{1+3\tau^2}$ is given by

a) 2 (b) 4 (c) 40 (d) 36

30. A random process is defined as $\begin{cases} A, & 0 \le t \le 1 \\ 0, & \text{otherwise} \end{cases}$, where A is uniformly distributed in $(-\theta, \theta)$. The autocorrelation function is

(a) $\frac{\theta^2}{2}$ (b) $\frac{\theta^2}{3}$ (c) $\frac{\theta^3}{3}$ (d) $\frac{\theta^2}{4}$

31. Two random processes X(t) and Y(t) are uncorrelated if $C_{XY}(t_1, t_2) =$

(a) $E[X(t_1)].E[Y(t_2)]$ (b) 0 (c) $R_{XX}(t_1, t_2)$ (d) 1

32. If X(t) and Y(t) are independent WSS processes with zero means then the autocorrelation function of {Z(t)} where $Z(t) = aX(t)Y(t)$ is

(a) $aR_{XX}(\tau)R_{YY}(\tau)$ (b) $a^2R_{XX}(\tau)R_{YY}(\tau)$ (c) $\sqrt{a}R_{XX}(\tau)R_{YY}(\tau)$ d) $\sqrt{aR_{XX}(\tau)R_{YY}(\tau)}$

33. In the fair coin experiment, a random process X(t) is defined as $X(t) = \cos \pi t$, if head occur and $X(t) = t$ if tail occur. E[X(t)] is

(a) $\frac{1}{2}(\cos \pi t + t)$ (b) $\frac{1}{4}\cos \pi t + \frac{3}{4}t$ (c) $\cos \pi t + t$ (d) $\frac{3}{4}\cos \pi t + \frac{1}{4}t$

34. If X(t) and Y(t) are orthogonal random processes, then $R_{XY}(t, t+\tau)$ is

(a) 0 (b) 1 (c) – 1 (d) ±1

35. Two random processes X(t) and Y(t) are ______________ if their covariance $C_{XY}(t, t+\tau) = 0$.

(a) uncorrelated (b) correlated (c) orthogonal (d) jointly WSS

36. A random process is defined by X(t) = A where A is a continuous RV with probability density function f(a) = 1, 0 < a < 1. Then mean of the process X(t) is

(a) 0 (b) 1 (c) 2 (d) 1/2

Module 5

1. If $Y(t+h) = f[X(t+h)]$ where $Y(t) = f[X(t)]$, f is called a __________ system.

(a) real (b) causal (c) time invariant (d) time dependent

2. If the value of the output Y(t) at $t = t_1$ depends only on the past values of the input X(t), $t \le t_1$, then the system is called a __________ system

(a) real time (b) causal (c) time invariant (d) time dependent

3. If the output $Y(t_1)$ at a given time $t = t_1$ depends only on $X(t_1)$ and not on any other values, then the system f is called a ____________ system.

(a) causal (b) time invariant (c) memoryless (d) time dependent

4. Two properties that are important in the study of linear system is

(a) time invariant and causality (b) causality & memory less property

© memoryless property & time invariant (d) time dependent & memoryless property

5. The mean square of the process {X(t)} is

(a) $R_{XX}(\tau)$ (b) $R_{XX}(0)$ (c) $-R_{XX}(\tau)$ (d) $-R_{XX}(0)$

6. If the unit impulse response function h(t) is absolutely integrable viz $\int_{-\infty}^{\infty} |h(t)|\,dt < \infty$, then the system is said to be

(a) stable (b) linear (c) causal (d) memoryless

7. Real $S_{XY}(\omega)$ and real $S_{YX}(\omega)$ are _________ functions of ω

(a) linear (b) even (c) odd (d) neither even nor odd

8. Im $S_{XY}(\omega)$ and Im $S_{YX}(\omega)$ are _________ functions of ω

(a) linear (b) even (c) odd (d) neither even nor odd

9. The average of power of random process {X(t)} is defined as

(a) $R_{XX}(\tau)$ (b) $R_{XX}(0)$ (c) $R_{XX}(-\tau)$ (d) $S_{XX}(0)$

10. The convolution form of the output of linear time invariant system is

(a) $Y(t) = \int_{-\infty}^{\infty} h(u)X(t-u)du$ (b) $Y(t) = \int_{-\infty}^{\infty} h(t)X(t-u)du$

(c) $Y(t) = \int_{0}^{\infty} h(u)X(t-u)du$ (d) $Y(t) = \int_{-\infty}^{\infty} h(t)X(u)du$

11. Unit impulse response for a causal system h(t) is zero when

(a) t > 0 (b) t = 0 (c) t < 0 (d) t ≥ 0

12. The power spectral density of a random signal with autocorrelation function $e^{-\lambda|\tau|}$ is

(a) $\frac{\lambda}{\lambda^2+\omega^2}$ (b) $\frac{\omega}{\lambda^2+\omega^2}$ (c) $\frac{2\lambda}{\lambda^2+\omega^2}$ (d) $\frac{2\omega}{\lambda^2+\omega^2}$

13. The power spectral density of a random process X(t) is given by $S_{XX}(\omega) = \begin{cases} \pi, & if\ |\omega|<1 \\ 0, & elsewhere \end{cases}$, then its autocorrelation is

(a) $\sin\tau$ (b) $-\sin\tau$ (c) $\cos\tau$ (d) $\frac{\sin\tau}{\tau}$

14. Let X(t) be a WSS process which is the input to a linear time invariant system with unit impulse h(t) and output Y(t). Then $S_{YY}(\omega) =$

(a) $H(\omega)S_{XX}(\omega)$ (b) $|H(\omega)|S_{XX}(\omega)$ (c) $|H(\omega)|^2 S_{XX}(\omega)$ (d) $|H(\omega)|^2 R_{XX}(\tau)$

15. If X(t) is a WSS process and if $R_{XX}(\tau) = \rho e^{-3|\tau|}$ where ρ is a constant, $S_{XX}(\omega)$ is given by

(a) $\dfrac{6\rho}{9+\omega^2}$ (b) $\dfrac{3\rho}{9+\omega^2}$ (c) $\dfrac{6\omega}{9+\omega^2}$ (d) $\dfrac{3\omega}{9+\omega^2}$

16. The power spectral density of a WSS process is given by $S_{XX}(\omega) = \begin{cases} 1, & if\ |\omega| < \omega_0 \\ 0, & elsewhere \end{cases}$. The autocorrelation function is given by

(a) $\dfrac{\sin \omega_0 \tau}{\pi\tau}$ (b) $\dfrac{\sin^2 \omega_0 \tau}{\pi\tau}$ (c) $\dfrac{\sin^2 \omega_0 \tau}{\pi^2\tau^2}$ (d) $\dfrac{\sin^2 \frac{\omega_0 \tau}{2}}{\frac{\pi\tau}{2}}$

17. The power spectral density of a WSS process is always

(a) finite (b) zero (c) negative (d) non-negative

18. The average power of waveform $X(t) = A\cos(\omega_0 t + \theta)$ is

(a) $\dfrac{A}{\sqrt{2}}$ (b) $\dfrac{A^2}{4}$ (c) $\dfrac{A^2}{2}$ (d) A^2

19. The power density spectrum satisfies the following condition:

(a) $S_{XX}(\omega) = -S_{XX}(-\omega)$ (b) $S_{XX}(\omega) = S_{XX}(-\omega)$

(c) $S_{XX}(\omega) = \infty$ at $\omega = 0$ (d) $S_{XX}(\omega) = S_{XX}(\omega^2)$

20. If $S_{XX}(\omega)$ is the power density spectrum of X(t) then the power density spectrum of $\alpha X(t)$

(a) $\alpha S_{XX}(\omega)$ (b) $\alpha^2 S_{XX}(\omega)$ (c) $-\alpha S_{XX}(\omega)$ (d) $|\alpha|^2 S_{XX}(\omega)$

21. The mean square value of the process whose power density spectrum of $\dfrac{4}{4+\omega^2}$ is

(a) 1 (b) ½ (c) ¼ (d) 2

22. The power spectral density of a random process where $R_{XX}(\tau) = e^{-b|\tau|}$ is

(a) $\frac{1}{b^2+\omega^2}$ (b) $\frac{2b}{b^2+\omega^2}$ (c) $\frac{b}{2(b^2+\omega^2)}$ (d) $\frac{b}{b^2+\omega^2}$

23. If X(t) and Y(t) are orthogonal then

(a) $S_{XY}(\omega)=1$ (b) $S_{XY}(\omega)=0$ (c) $S_{XY}(\omega)=S_{YX}(\omega)$ (d) $S_{XY}(\omega)\leq 1$

24. The cross power spectrum $S_{XY}(-\omega)$ is

(a) $S_{XY}(\omega)$ (b) $-S_{XY}(-\omega)$ (c) $S_{YX}(\omega)$ (d) $-S_{YX}(-\omega)$

25. The spectral density of a stationary process whose autocorrelation function is $e^{-|\tau|}$ is

(a) $\frac{1}{1+\omega^2}$ (b) $\frac{2}{1+\omega^2}$ (c) $\frac{2}{(1+\omega^2)^2}$ (d) $\frac{1}{(1+\omega^2)^2}$