CBCS SCHEME

USN | | | | | | | | | |

17MATDIP41

Fourth Semester B.E. Degree Examination, July/August 2022
Additional Mathematics – II

Time: 3 hrs. Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

Module-1

1 a. Find the rank of a matrix $A = \begin{bmatrix} 1 & 2 & -2 & 3 \\ 2 & 5 & -4 & 6 \\ -1 & -3 & 2 & -2 \\ 2 & 4 & -1 & 6 \end{bmatrix}$ by reducing to echelon form. (07 Marks)

b. Use Cayley-Hamilton theorem to find the inverse of a matrix $\begin{bmatrix} 1 & 1 & 3 \\ 1 & 3 & -3 \\ -2 & -4 & -4 \end{bmatrix}$. (07 Marks)

c. Solve the following system of equation of Gauss Elimination method:
$x + y + z = 9$
$x - 2y + 3z = 8$
$2x + y - z = 3$. (06 Marks)

OR

2 a. Test for consistency and solve
$5x_1 + x_2 + 3x_3 = 20$
$2x_1 + 5x_2 + 2x_3 = 18$
$3x_1 + 2x_2 + x_3 = 14$. (07 Marks)

b. Find all the Eigenvalues of the matrix
$A = \begin{bmatrix} 8 & -6 & 2 \\ -6 & 7 & -4 \\ 2 & -4 & 3 \end{bmatrix}$. (07 Marks)

c. Find the rank of the matrix $A = \begin{bmatrix} 2 & 3 & 4 \\ -1 & 2 & 3 \\ 1 & 5 & 7 \end{bmatrix}$. (06 Marks)

Module-2

3 a. Solve $\frac{d^3y}{dx^3} - 2\frac{d^2y}{dx^2} + 4\frac{dy}{dx} - 8y = 0$. (07 Marks)

b. Solve $y'' - 4y' + 13y = \cos 2x$. (07 Marks)

c. Solve $\frac{d^3y}{dx^3} + 2\frac{d^2y}{dx^2} + \frac{dy}{dx} = x^3$. (06 Marks)

OR

4 a. Solve by the method of variation of parameters, $y'' - 2y' + y = e^x.\log x$. (07 Marks)

b. Solve by the method of undetermined coefficients $(D^2 + 1)y = \sin x$. (07 Marks)

c. Solve $\frac{d^2y}{dx^2} - 4y = 3^x$. (06 Marks)

Module-3

5 a. Find the Laplace transform of $\cos t \times \cos 2t.\cos 3t$. (07 Marks)

b. Find the Laplace transform of $e^{3t}\sin 5t.\sin 3t$. (07 Marks)

c. Find the Laplace transform of $t^3 \sin t$. (06 Marks)

OR

6 a. If f(t) is a periodic function of period T > 0, then prove that $L\{f(t)\} = \dfrac{1}{1-e^{-sT}}\int_0^T e^{-st}f(t)dt$. (07 Marks)

b. Find the Laplace transform of $f(t) = E\sin wt$, $0 < t < \pi/w$ having period π/w. (07 Marks)

c. Express $f(t) = \begin{cases} \cos t & 0 < t < \pi \\ \cos 2t & \pi < t < 2\pi \\ \cos 3t & t > 2\pi \end{cases}$ as a unit step function and hence find its Laplace transform. (06 Marks)

Module-4

7 a. Find the Laplace of $\dfrac{1}{(s-1)(s+1)(s+2)}$. (07 Marks)

b. Solve $y''' + 2y'' - y' - 2y = 0$ given $y(0) = y'(0) = 0$ and $y''(0) = 6$ by using Laplace transform. (07 Marks)

c. Find: $L^{-1}\left[\dfrac{3s+2}{(s-2)(s+1)}\right]$. (06 Marks)

OR

8 a. Find $L^{-1}[\cot^{-1}(s/a)]$. (07 Marks)

b. Employ Laplace transform to solve the equation $y'' + 5y' + 6y = 5e^{2x}$, $y(0) = 2$, $y'(0) = 1$. (07 Marks)

c. Find the inverse Laplace transform of $\log\left[\dfrac{s+4}{s-4}\right]$. (06 Marks)

Module-5

9 a. State and prove Bayes theorem. (07 Marks)

b. Prove that
$P(A\cup B\cup C) = P(A) + P(B) + P(C) + P(A\cap B\cap C) - P(A\cap B) - P(B\cap C) - P(C\cap A)$. (07 Marks)

c. A pair of dice is tossed twice. Find the probability of scoring 7 points
i) Once ii) atlesat once iii) twice. (06 Marks)

OR

10 a. If A and B are two events having P(A) = 1/2, P(B) = 1/3 and $P(A\cap B) = 1/4$ compute
i) $P(A/B)$ ii) $P(B/A)$ iii) $P(\overline{A}/\overline{B})$. (07 Marks)

b. Three machines A, B and C produce respectively 60%, 30%, 10% of the total number of items of a factory. The percentage of defective output of these machines are respectively 2%, 3% and 4%. An item is selected at random and is found defective. Find the probability that the item was produced by machine C. (07 Marks)

c. In a school 25% of the students failed in first language, 15% of the students failed in second language and 10% of the students failed in both. If a student is selected at random find the probability that.
i) He failed in first language if he had failed in the second language.
ii) He failed in second language if he had failed in the first language.
iii) He failed in either of the two languages. (06 Marks)

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CBCS SCHEME

USN | | | | | | | | | | 17EC42

Fourth Semester B.E. Degree Examination, July/August 2022
Signals and Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Sketch the even and odd part of the signals shown in Fig.Q1(a)(i) and (ii)

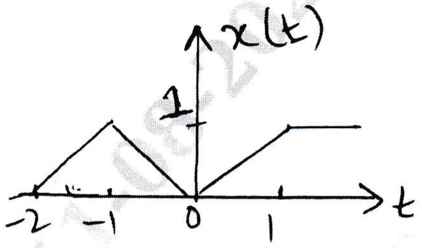

Fig Q1(a)(i)

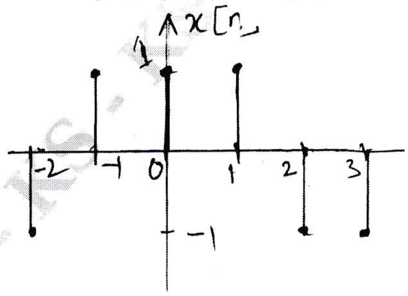

Fig Q1(a)(ii) **(10 Marks)**

b. Determine whether the following systems are memoryless, causal, time invariant linear and stable. i) $y[n] = n\,x[n]$ ii) $y(t) = \text{Cos}\,(x(t))$ **(10 Marks)**

OR

2 a. A continuous time signal x(t) and g(t) is shown in Fig.Q2(a)(i) and (ii), express x(t) in terms of g(t).

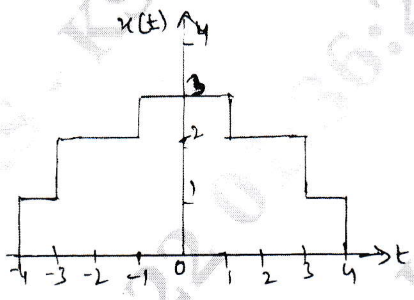

Fig.Q2(a)(i)

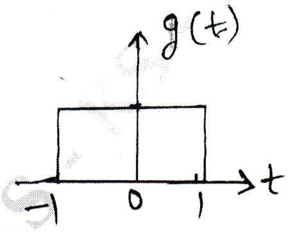

Fig.Q2(a)(ii) **(06 Marks)**

b. Determine whether the following signal is periodic or not. If periodic find the fundamental period. $x(t) = \text{Cos}(5\pi t) + \text{Sin}\,(6\pi t)$. **(04 Marks)**

c. For the signal x(t) and y(t) shown in Fig.Q2(c)(i) and (ii). Sketch the signal $x(2t)\,y(2t+1)$.

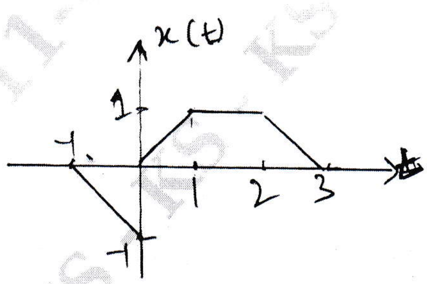

Fig.Q2(c)(i)

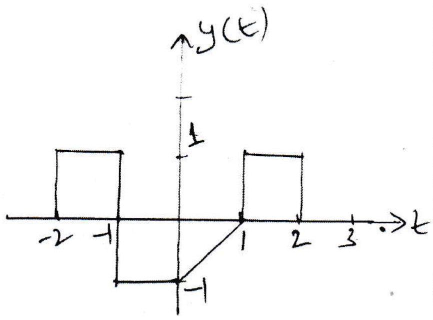

Fig.Q2(c)(ii) **(10 Marks)**

Module-2

3 a. Derive the equation for convolution sum. (06 Marks)

b. State and prove commutative property of convolution sum. (04 Marks)

c. Compute the following convolution

i) $y(t) = u(t + 1) * u(t - 2)$ ii) $y[n] = \beta^n u[n] * [n - 3]$. (10 Marks)

OR

4 a. Compute the convolution integral of $x_1(t)$ and $x_2(t)$ given $x_1(t) = \cos \pi t(u(t + 1) - u(t - 3))$ $x_2(t) = u(t)$. (10 Marks)

b. Consider a LTI system with input x[n] and unit impulse response h[n] given below. Compute and plot the output signal y[n] $x[n] = 2^n u(-n)$ $h[n] = u[n]$. (10 Marks)

Module-3

5 a. Consider the interconnection of LTI systems depicted in Fig Q5(a). The impulse response of each system is given as $h_1[n] = u[n]$, $h_2[n] = u[n+2] - u[n]$, $h_3[n] = \delta[n - 2]$, $h_4[n] = \alpha^n u[n]$. Find the overall impulse response of the system.

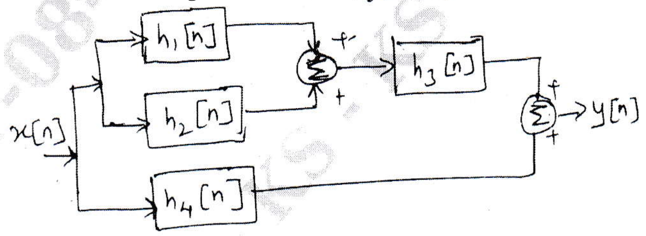

Fig Q5(a) (06 Marks)

b. Determine whether the following system defined by their impulse response are memoryless, causal and stable. Justify your answer.

i) $h(t) = e^t u(-1 - t)$ ii) $h[n] = \cos(n)\, u[n]$. (06 Marks)

c. A continuous time LTI system has step response $s(t) = e^{-t}u(t)$. Find and sketch the output of the system to the input x(t) shown in Fig Q5(c).

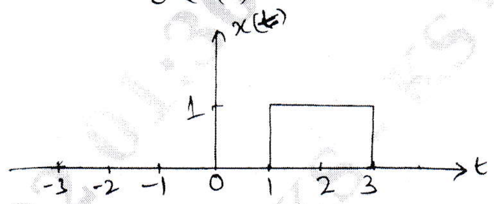

Fig Q5(c) (08 Marks)

OR

6 a. Determine the DTFS coefficients of $x[n] = \cos\left(\frac{6\pi}{13}n + \frac{\pi}{6}\right)$ and draw the magnitude spectrum and phase spectrum. (10 Marks)

b. State the following properties of CTFS. i) Linearity ii) Time shift iii) Frequency shift iv) Scaling v) Time Differentiation vi) Convolution. (10 Marks)

Module-4

7 a. State and prove the following properties

i) $-jtx(t) \xleftrightarrow{FT} \frac{dx(w)}{dw}$ ii) $\int_{-\infty}^{\infty} |x(t)|^2\, dt = \frac{1}{2\pi}\int_{-\infty}^{\infty} |x(jw)|^2\, dw$ (10 Marks)

b. The output x(t) of an ideal low pass filter which has cut off frequency $w_c = 1000\pi$ rad/sec in impulse sampled with the following sampling periods i) $T_s = 0.5 \times 10^{-3}$ ii) $T_s = 2 \times 10^{-3}$ iii) $T_s = 10^{-4}$. Which of these sampling periods would guarantee that x(t) can be recovered from its sampled version. (05 Marks)

c. Find the Fourier Transform for the signal x(t) shown in Fig Q7(c).

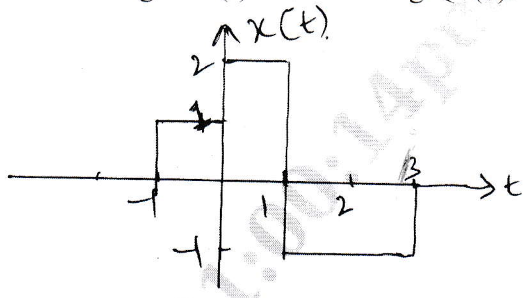

Fig Q7(c) **(05 Marks)**

OR

8 a. Find the DTFT of the following signals

i) $x[n] = 2^n u[-n]$ ii) $x[n] = \mathrm{Sin}\left(\frac{\pi}{4}n\right)\left(\frac{1}{4}\right)^n u(n-1)$ **(10 Marks)**

b. Determine the time domain signals corresponding to the following FT's

i) $x(jw) = e^{-|w|}$ ii) $x(jw) = \left(\frac{2jw+1}{(jw+2)^2}\right)$ **(10 Marks)**

Module-5

9 a. State and prove Time Reversal and Differentiation in the z-domain property of Z-Transforms. **(10 Marks)**

b. Find the inverse Z-transform of

i) $x(z) = \frac{z^2 - 3z}{z^2 + \frac{3}{2}z - 1}$ $\frac{1}{2} < |z| < 2$ ii) $x(z) = \frac{8z^2 + 4z}{4z^2 - 4z + 1}$ $|z| > \frac{1}{2}$. **(10 Marks)**

OR

10 a. Use properties of z-transform to compute x(z) of

i) $x(n) = n\,\mathrm{Sin}\left(\frac{\pi}{2}n\right)u(-n)$ ii) $x(n) = n^2\left(\frac{1}{2}\right)^n u(n-3)$ **(12 Marks)**

b. Determine the transfer function and the impulse response for the causal LTI system if $x(n) = \delta(n) + \frac{1}{4}\delta(n-1) - \frac{1}{8}\delta(n-2)$ and $y(n) = \delta(n) - \frac{3}{4}\delta(n-1)$. **(08 Marks)**

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CBCS SCHEME

USN [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ] [ ]   **17EC43**

Fourth Semester B.E. Degree Examination, July/August 2022
Control Systems

Time: 3 hrs.   Max. Marks: 100

Note: 1. Answer any FIVE full questions, choosing ONE full question from each module.
2. No Handbook, No Charts, No Tables permitted.

Module-1

1 a. Define control system. Compare open loop and closed loop system. **(06 Marks)**

b. Find the transfer function $\frac{X(s)}{E(s)}$ for a electrochemical system shown in Fig.Q1(b).

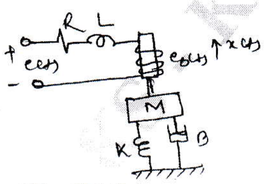

Fig.Q1(b) **(06 Marks)**

c. The system block diagram is shown in Fig.Q1(c). Find C(s)/R(s).

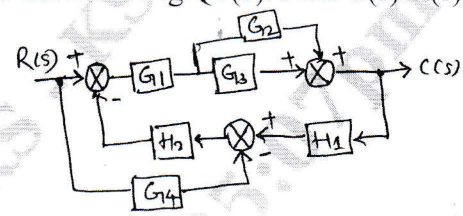

Fig.Q1(c) **(08 Marks)**

OR

2 a. Define the signal flow graph and list the properties of signal flow graph. **(06 Marks)**

b. Find C(s)/R(s) by Mason's gain formula shown in Fig.Q2(b).

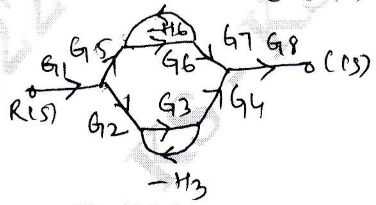

Fig.Q2(b) **(08 Marks)**

c. For the mechanical system shown in Fig.Q2(c)

(i) Draw the mechanical network (ii) Draw force – voltage analogous electric network.

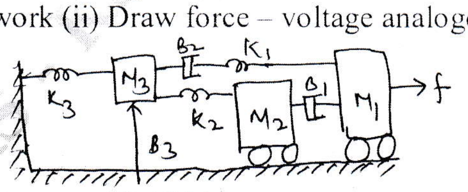

Fig.Q2(c) **(06 Marks)**

Module-2

3 a. Define the following time response specifications for an underdamped 2nd order system:

(i) Rise time t_r (ii) Peak time t_p (iii) Peak overshoot M_p (iv) Settling time t_s **(04 Marks)**

b. For the system shown in the Fig.Q3(b) obtain the closed loop transfer function damping ratio natural frequency and expression for the output response if subjected to unit step input.

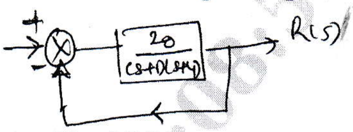

Fig.Q3(b) **(08 Marks)**

c. The response of servo mechanism is $c(t) = 1 + 0.2e^{-60t} - 1.2e^{-10t}$ when subjected to a unit step input, obtain an expression for the closed loop transfer function. Determine natural frequency and damping ratio. **(08 Marks)**

OR

4 a. Explain the PID controller and its effect. **(04 Marks)**

b. For a unity feedback control system with $G(s)=\dfrac{10(s+2)}{s^2(s+1)}$, find

(i) The static error coefficients

(ii) Steady state error when the input transform is $R(s) = 3/s + 2/s^2 + 1/3s^3$. **(08 Marks)**

c. A unity feedback system has $G(s) = \dfrac{40(s+2)}{s(s+1)(s+4)}$

(i) Determine All error coefficient (ii) Error for ramp input and magnitude of 4. **(08 Marks)**

Module-3

5 a. State and explain Routh's stability criterion for determining stability of the system. **(04 Marks)**

b. A unity feedback control system has $G(s) = 20k / [s(s+1)(s+5)+20]$, where $r(t) = 2t$

It is desired that for ramp input $e_{ss} \leq 1.5$. What minimum value must k have for this condition to be satisfied? With this k, is the system stable? **(08 Marks)**

c. A unity feedback system has $G(s)=\dfrac{k(s+13)}{s(s+3)\times(s+1)}$, using Routh's criterion calculate the range of 'k' for which the system is (i) Stable (ii) has its closed loop, poles more negative than −1. **(08 Marks)**

OR

6 a. Derive the condition used to determine the trajectories of the root loci in the S-plane. **(04 Marks)**

b. For a system having $G(s)H(s)=\dfrac{k}{s(s+3)(s^2+3s+11.25)}$

Find the valid break away points and angle of departure. **(08 Marks)**

c. Sketch the rough nature of the root locus of a certain control system whose characteristics equation is given by $s^3 + 9s^2 + Ks + K = 0$. Comment on stability. **(08 Marks)**

Module-4

7 a. Derive the expression for resonant peak M_r and resonant frequency W_r for a standard second order system in terms of ξ and ω_n. **(06 Marks)**

b. The closed loop transfer function of a feedback system is given by

$$T(s) = 1000/(s+22.5)(s^2 + 2.45s + 44.4)$$

Determine

(i) resonance peak M_r and resonant frequency (W_r) of the system by drawing the frequency response curve.

(ii) What should be values of damping ratio (ξ) and undamped natural frequency (ω_n) of an equivalent 2nd system which will produce the same M_r and W_r as determined in part (i)

(iii) Determine the bandwidth of the equivalent 2nd order system. **(14 Marks)**

OR

8 a. Sketch the Bode plot for the transfer function

$$G(s) = ks^2 / (1 + 0.2s)(1 + 0.2s)$$

Determine the value of 'k' for the gain cross-over frequency to be 5 Rad/sec. **(10 Marks)**

b. What is polar plot and list its applications. **(04 Marks)**

c. State the effects of lag and lead compensating networks. **(06 Marks)**

Module-5

9 a. Explain the terms (i) State (ii) State variable (iii) State vector (iv) State space **(04 Marks)**

b. Obtain the state equation and output equation of the electric network as shown in Fig.Q9(b).

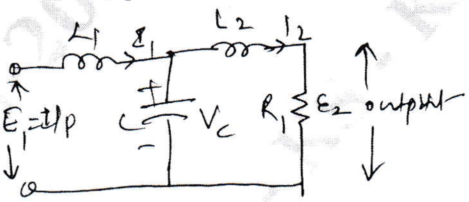

Fig.Q9(b) **(10 Marks)**

c. Explain spectrum analysis of sampling process. **(06 Marks)**

OR

10 a. State the properties of state transition matrix. **(06 Marks)**

b. What is Signal Reconstruction? Explain it with SAMPLE and HOLD circuit. **(06 Marks)**

c. Obtain the transition matrix Q(t) of the following system

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -2 & -3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix}.$$

Also obtain the inverse of the transition matrix $\phi^{1}(t)$ **(08 Marks)**

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CBCS SCHEME

USN | | | | | | | | | | | **17EC44**

Fourth Semester B.E. Degree Examination, July/August 2022
Principles of Communication Systems

Time: 3 hrs. Max. Marks: 100

Note: ***Answer any FIVE full questions, choosing ONE full question from each module.***

Module-1

1 a. Define amplitude modulation and modulation index sketch the standard AM wave for $\mu < 1$, $\mu = 1$ and $\mu > 1$. Also derive the equation for μ interms of A_{max} and A_{min}. **(06 Marks)**

b. With the help of necessary circuit diagram, waveforms and equations, explain the generation of standard AM signal. Using switching modulator. **(07 Marks)**

c. An audio frequency signal 10 sin 2π 500t is used to amplitude modulate a carrier signal 50 sin $2\pi \times 10^5$t. If $\mu = 0.2$, determine sideband frequencies, amplitude of teach sideband, bandwidth required, PC and PT. Also sketch frequency spectrum. Assume $R = 600\Omega$. **(07 Marks)**

OR

2 a. Explain the operation of QCM system. **(06 Marks)**

b. What is quadrature null effect of the coherent detector? Explain the practical synchronous receiving system. **(07 Marks)**

c. Explain the VSB transmission of analog and digital television signals. **(07 Marks)**

Module-2

3 a. Derive the equation of signal tone frequency modulated signal. Also explain the relationship between FM and PM. **(06 Marks)**

b. With the help of necessary circuit diagram and equations, explain the working FM generation using VCO. Draw the block diagram of feedback scheme for generation of frequency stabilized FM wave. **(07 Marks)**

c. An angle modulated signal is represented by,
$s(t) = 10 \cos [2\pi \times 10^6 t + 5 \sin 2000\pi t + 10 \sin 3000\pi t]$ volts. Determine the following :
i) The power in the modulated signal
ii) The frequency deviation
iii) The deviation ratio
iv) The phase deviation
v) Transmission bandwidth. **(07 Marks)**

OR

4 a. Explain the operation of FM stereo multiplexing. **(06 Marks)**

b. What is PLL? Explain the linear model and nonlinear model of PLL for demodulation of FM signals. **(09 Marks)**

c. Write short notes on nonlinear effects in FM systems. **(05 Marks)**

Module-3

5 a. Describe mean autocorrelation and co-variance functions with respect to random process. **(06 Marks)**

b. What is noise equivalent bandwidth? Derive the expression for noise equivalent bandwidth of low pass filter. **(08 Marks)**

c. A random variable 'X' has the following distribution function :

$$F_X(x) = \begin{cases} 0 & ; \quad x < 0 \\ x/8 & ; \quad 0 \le x \le 2 \\ x^2/16 & ; \quad 2 \le x \le 4 \\ 1 & ; \quad 4 \le x \end{cases}$$

Determine mean, variance and standard deviation. **(06 Marks)**

OR

6 a. Explain the following :
i) Short noise
ii) Thermal noise
iii) White noise. **(06 Marks)**

b. What is cross correlation? Explain the properties of cross-correlation. **(08 Marks)**

c. Calculate the RMS noise voltage and thermal noise power appearing across a 20KΩ resistor at 25°C temperature with an effective noise bandwidth of 10KHz. **(06 Marks)**

Module-4

7 a. Discuss the noise in DSBSC receiver with a model receiver using coherent detection. Prove that the figure of merit for such a receiver is unity. **(07 Marks)**

b. Derive the expression for output signal – to – noise ratio of an AM receiver using an envelope detector. **(08 Marks)**

c. A carrier reaching an envelope detector in an AM receiver has an RMS value equal to 1 volt in the absence of modulation. The noise at the input of the envelope detector has a PSD equal to 10^{-3}watts/Hz. If the carrier is modulated to a depth of 100% and message bandwidth W = 3.2KHz, determine output signal – to – noise ratio. **(05 Marks)**

OR

8 a. Explain the concepts of capture effect, FM threshold effect and FM threshold reduction. **(07 Marks)**

b. Derive the expression for figure of merit of a noisy FM receiver using the frequency discriminator. **(08 Marks)**

c. An FM signal with a deviation of 75KHz is applied to an FM demodulator. When the input SNR is 15dB, the modulating frequency is 10KHz determine the SNR at the demodulator output. **(05 Marks)**

Module-5

9 a. State sampling theorem for low pan signals find the Nyquist rate and Nyquist interval of $m(t) = \frac{1}{2\pi}\cos 4000\pi t \cdot \cos 1000\pi t$. (05 Marks)

b. With the help of relevant block diagram and waveforms, explain the generation and detection of PAM signal. (08 Marks)

c. Explain the operation of TDM system. (07 Marks)

OR

10 a. An analog waveform with bandwidth 15KHz is to be quantized with 200 levels and transmitted via binary PCM signal. Find the rate of transmission and bandwidth required. If 10 such signals are to be multiplexed, find the bandwidth requirement. (05 Marks)

b. Explain the generation and detection of PPM waves. (08 Marks)

c. With the help of block diagram explain the working VOCODER. (07 Marks)

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