Q. 1- Q. 25 carry one mark each.

Q.1 If $\mathbf{A}$ is Hermitian, then $i\mathbf{A}$ is

(A) Symmetric
(B) Skew-symmetric
(C) Hermitian
(D) Skew-Hermitian

Q.2 If $u = \log\dfrac{x^2 + y^2}{x + y}$, then $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y}$ is equal to

(A) 0
(B) 1
(C) u
(D) eu

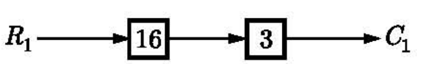
Q.3 The probability that a man who is x years old will die in a year is p. Then amongst n persons $A_1, A_2, ..., A_n$ each x years old now, the probability that, A_1 will die in one year is

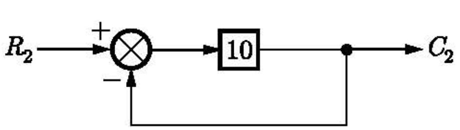
(A) $\dfrac{1}{n^2}$
(B) $1 - (1 - p)^n$
(C) $\dfrac{1}{n^2}[1 - (1 - p)^n]$
(D) $\dfrac{1}{n}[1 - (1 - p)^n]$

Q.4 If the closed-loop transfer function of a control system is $T(s) = \dfrac{s - 5}{(s + 2)(s + 3)}$ then It is

(A) an unstable system
(B) an uncontrollable system
(C) a minimum phase system
(D) a non-minimum phase system

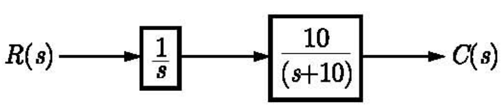
Q.5 Consider the systems shown below. If the forward path gain is reduced by 10% in each system then the variation in C_1 and C_2 will be respectively





(A) 10% and 1%
(B) 2% and 10%
(C) 0% and 0%
(D) 5% and 1%

Q.6 A system is shown in below. The rise time and settling time for this system is



(A) 0.22 s, 0.4 s

(B) 0.4 s, 0.22 s

(C) 0.12 s, 0.4 s

(D) 0.4 s, 0.12 s

Q.7 Two infinitely long parallel filaments each carry 100 A in the $\mathbf{u}_z$ direction. If the filaments lie in the plane $y=0$ at $x=0$ and $x=5$ mm, the force on the filament passing through the origin is

(A) $0.4\mathbf{u}_x$ N/m

(B) $-0.4\mathbf{u}_x$ N/m

(C) $4\mathbf{u}_x$ mN/m

(D) $-4\mathbf{u}_x$ mN/m

Q.8 The phasor magnetic field intensity for a 400 MHz uniform plane wave propagating in a certain lossless material is $(6\mathbf{u}_y - j5\mathbf{u}_z)\, e^{j18x}$ A/m. The phase velocity v_ρ is

(A) 6.43×10^6 m/s

(B) 2.2×10^7 m/s

(C) 1.4×10^8 m/s

(D) None of the above

Q.9 A mast antenna consisting of a 50 meter long vertical conductor operates over a perfectly conducting ground plane. It is base-fed at a frequency of 600 kHz. The radiation resistance of the antenna in Ohm is

(A) $\frac{2\pi^2}{5}$

(B) $\frac{\pi^2}{5}$

(C) $\frac{4\pi^2}{5}$

(D) $20\pi^2$

Q.10 A carrier is simultaneously modulated by two sine waves with modulation indices of 0.4 and 0.3. The resultant modulation index will be

(A) 1.0

(B) 0.7

(C) 0.5

(D) 0.35

Q.11 An FM wave use a 2-5 V, 500 Hz modulating frequency and has a modulation index of 50. The deviation is

(A) 500 Hz

(B) 1000 Hz

(C) 1250 Hz

(D) 25000 Hz

Q.12 A fast FH/MFSK system has the following parameters.
Number of bits per MFSK symbol = 4
Number of pops per MFSK symbol = 4
The processing gain of the system is

(A) 0 dB

(B) 7 dB

(C) 9 dB

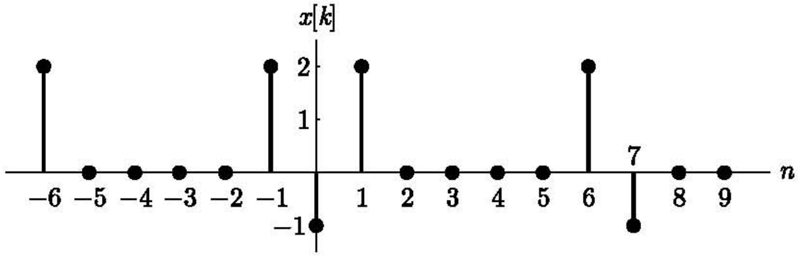
(D) 12 dB

Q.13 The Fourier transform of signal $sgn(t)$ is

(A) $\frac{-2}{j\omega}$ (B) $\frac{4}{j\omega}$

(C) $\frac{2}{j\omega}$ (D) $\frac{1}{j\omega}+1$

Q.14 The DTFS coefficient of a signal $x[n]$ is as show below



The signal $x[n]$ is

(A) $2\sin\left(\frac{\pi}{7}n\right)-1$ (B) $2\cos\left(\frac{\pi}{7}n\right)-1$

(C) $4\sin\left(\frac{2\pi}{7}n\right)-1$ (D) $4\cos\left(\frac{2\pi}{7}n\right)-1$

Q.15 The impulse response of a continuous-time LTI system is $h(t)=e^{6t}u(3-t)$. The system is

(A) causal and stable (B) causal but not stable

(C) stable but not causal (D) neither causal nor stable

Q.16 A combinational circuit has input A, B, and C and its K-map is as shown below. The output of the circuit is given by

A \ CD	00	01	11	10
00		1		1
01	1		1	

(A) $(\overline{A}B+A\overline{B})\,\overline{C}$ (B) $(AB+\overline{A}\,\overline{B})\,\overline{C}$

(C) $\overline{A}\,\overline{B}\,\overline{C}$ (D) $A\oplus B\oplus C$

Q.17 A n bit A/D converter is required to convert an analog input in the range of $0-5$ V to an accuracy of 10 mV. The value of n should be

(A) 8 (B) 10

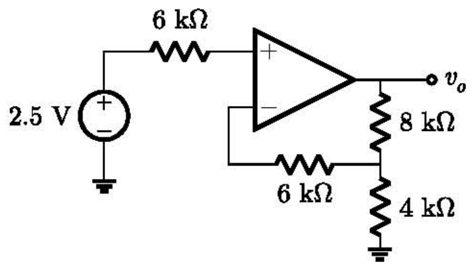
(C) 9 (D) 16

Q.18 What is addition of $(-64)_{10}$ and $(80)_{16}$?

(A) $(-16)_{10}$ (B) $(16)_{10}$

(C) $(1100000)_2$ (D) $(01000000)_2$

Q.19 For the circuit shown below the value of v_o is



(A) −7.5 V (B) 7.5 V

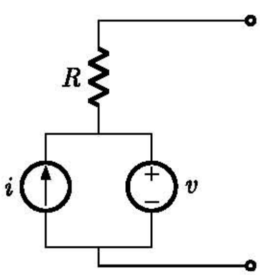
(C) 8 V (D) −8 V

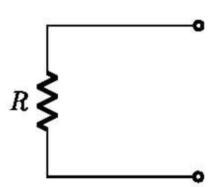
Q.20 In order to form a structure containing both pnp and npn transistors, monolithic IC requires

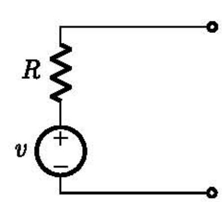
(A) 3 layers (B) 4 layers

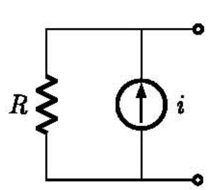
(C) 5 layers (D) 6 layers

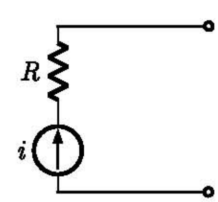
Q.21 A simple equivalent circuit of the 2 terminal network shown in figure is



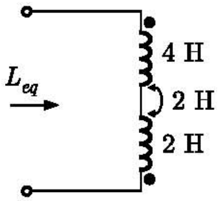
(A) 

(B) 

(C) 

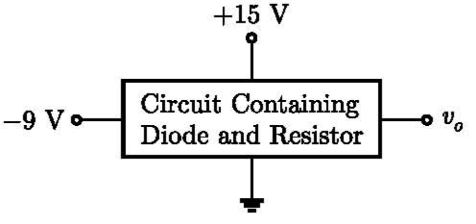
(D) 

Q.22 The equivalent inductance L_{eq} is



(A) 2 H
(B) 4 H
(C) 6 H
(D) 8 H

Q.23 The circuit inside the box in figure shown below contains only resistor and diodes. The terminal voltage v_o is connected to some point in the circuit inside the box.



The largest and smallest possible value of v_o most nearly to is respectively

(A) 15 V, 6 V
(B) 24 V, 0 V
(C) 24 V, 6 V
(D) 15 V, −9 V

Q.24 Which of the following amplifier has high input resistance and high output resistance

(A) Common-source

(B) Common-drain

(C) Common-gate

(D) None of these

Q.25 A lag compensation network

(A) increases the gain of the original network without affecting stability.

(B) reduces the steady state error.

(C) reduces the speed of response

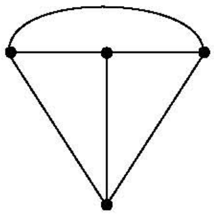
(D) permits the increase of gain of phase margin is acceptable.

In the above statements, which are correct

(A) a and b
(B) b and c
(C) b,c, and d
(D) all

Q. 26- Q. 55 carry two mark each.

Q.26 The graph of a network is shown below. The number of possible tree are



(A) 8 (B) 12

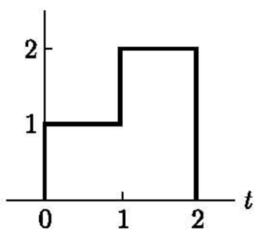
(C) 16 (D) 20

Q.27 For the signal $x(t)$ as below

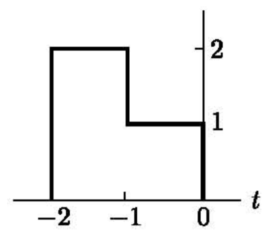
$x(t) = u(t) + u(t+1) - 2u(t+2)$

The correct waveform is

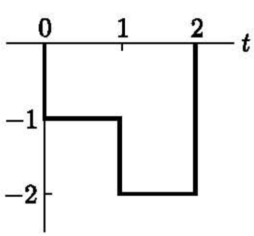
(A)



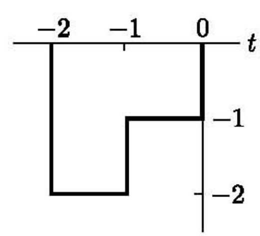
(B)



(C)



(D)



Q.28 An 8085 executes the following instructions

2710	LXI H,	30A0 H
2713	DAD	H
2714	PCHL	

All address and constants are in Hex. Let PC be the contents of program counter and HL be the contents of the HL register pair just after executing PCHL. Which of the following statements is correct ?

(A) PC = 2715 H
HL = 30A0H

(B) PC = 30A0H
HL = 2715H

(C) PC = 6140H
HL = 6140H

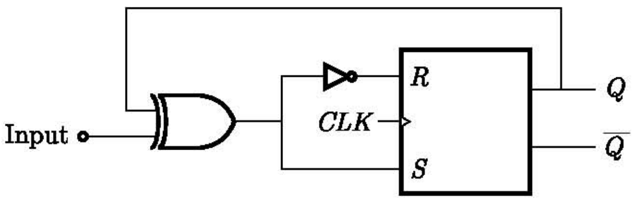
(D) PC = 6140H
HL = 2715H

Q.29 The minimum number of NOR gates required to implement $A(A+\overline{B})(A+\overline{B}+C)$ is equal to

(A) 0 (B) 3

(C) 4 (D) 7

Q.30 Consider a circuit shown in figure. The circuit functions as



(A) D-flip-flop (B) T-flip-flop

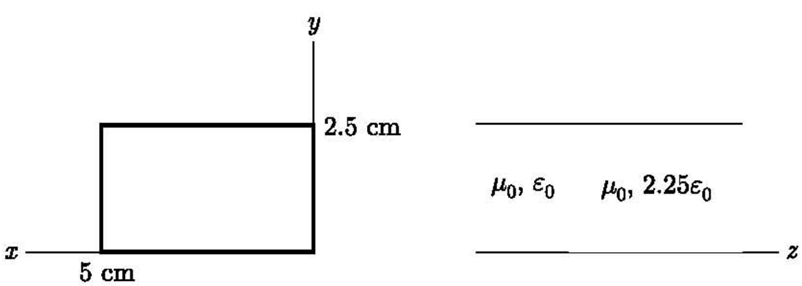
(C) Output remains stable at '1' (D) Output remains stable at '0'

Q.31 A 81 Ω lossless planer line was designed but did not meet a requirement. To get the characteristic impedance of 75 Ω the fraction of the width of the strip should be

(A) added by 4% (B) removed by 4%

(C) added by 8% (D) removed by 8%

Q.32 The cross section of a waveguide is shown in fig. It has dielectric discontinuity as shown in fig. If the guide operate at 8 GHz in the dominant mode, the standing wave ratio is



(A) -3.911 (B) 2.468

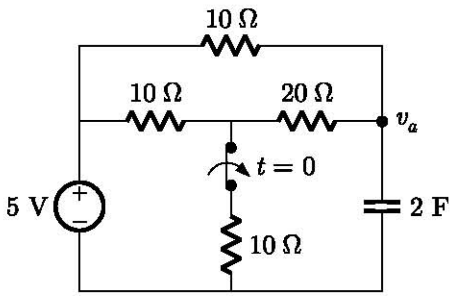
(C) 1.564 (D) 4.389

Q.33 A point charge of 2×10^{16} C and 5×10^{26} kg is moving in the combined fields $\mathbf{B} = -3\mathbf{u}_x + 2\mathbf{u}_y - \mathbf{u}_z$ mT and $\mathbf{E} = 100\mathbf{u}_x - 200\mathbf{u}_y - 300\mathbf{u}_z$ V/m. If the charge velocity at $t=0$ is $\mathbf{v}(0) = (2\mathbf{u}_x - 3\mathbf{u}_y - 4\mathbf{u}_z)10^5$ m/s, the acceleration of charge at $t=0$ is

(A) $600[3\mathbf{u}_x + 2\mathbf{u}_y - 3\mathbf{u}_z]10^9$ m/s^2 (B) $400[6\mathbf{u}_x + 6\mathbf{u}_y - 3\mathbf{u}_z]10^9$ m/s^2

(C) $400[6\mathbf{u}_x - 6\mathbf{u}_y + 3\mathbf{u}_z]10^9$ m/s^2 (D) $800[6\mathbf{u}_x + 6\mathbf{u}_y - \mathbf{u}_z]10^9$ m/s^2

Q.34 In the circuit shown below a steady state is reached with switch open. At $t = 0$ the switch is closed. The value of $v_a(\infty)$ is



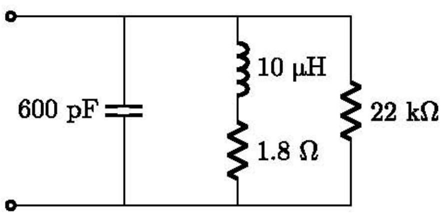
(A) $\frac{30}{7}$ V

(B) $-\frac{30}{7}$ V

(C) $\frac{40}{7}$ V

(D) $-\frac{40}{7}$ V

Q.35 For the circuit shown below the resonant frequency f_0 is



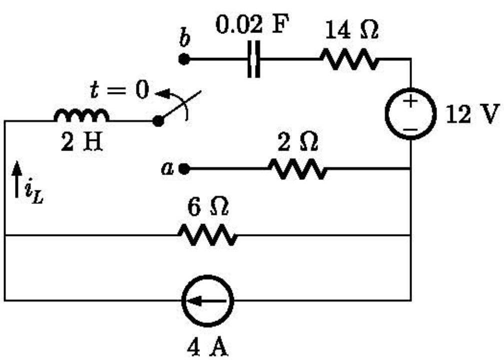
(A) 12.9 kHz

(B) 12.9 MHz

(C) 2.05 MHz

(D) 2.05 kHz

Q.36 In the circuit shown below switch is moved from position a to b at $t = 0$.



The $i_L(t)$ for $t > 0$ is

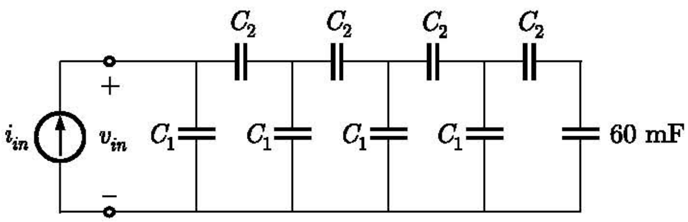
(A) $(4 - 6t)\,e^{4t}$ A

(B) $(3 - 6t)\,e^{4t}$ A

(C) $(3 - 9t)\,e^{5t}$ A

(D) $(3 - 8t)\,e^{5t}$

Q.37 In the circuit shown in figure $i_{in}(t) = 300 \sin 20t$ mA, for $t \geq 0$.



Let $C_1 = 40$ µF and $C_2 = 30$ μF. All capacitors are initially uncharged. The $v_{in}(t)$ would be

(A) $-0.25 \cos 20t$ V

(B) $0.25 \cos 20t$ V

(C) $-36 \cos 20t$ mV

(D) $36 \cos 20t$ mV

Q.38 The thermal-equilibrium concentration of hole p_0 in silicon at $T = 300$ K is 10^{15} cm ^{3}. The value of n_0 is

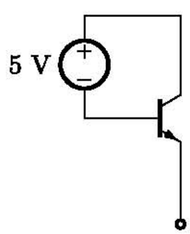
(A) 3.8×10^{8} cm ^{3}

(B) 4.4×10^{4} cm ^{3}

(C) 2.6×10^{4} cm ^{3}

(D) 4.3×10^{8} cm ^{3}

Q.39 For the transistor in circuit shown below, $I_s = 10^{\ 15}$ A, $\beta_F = 100$, $\beta_R = 1$. The current I_{CBO} is



(A) $1.01 \times 10^{\ 14}$ A

(B) $2 \times 10^{\ 14}$ A

(C) $1.01 \times 10^{\ 15}$ A

(D) $2 \times 10^{\ 15}$ A

Q.40 Consider the three LTI systems with impulse response

$$h_1(t) = u(t), \qquad h_2(t) = -2\delta(t) + 5e^{\ 2t} u(t), \qquad h_3(t) = 2te^{\ t} u(t)$$

The response to $x(t) = \cos t$ of above systems are

$$y_1(t) = x(t) * h_1(t), \qquad y_2(t) = x(t) * h_2(t), \qquad y_3(t) = x(t) * h_3(t)$$

The same response are

(A) All $y_1(t), y_2(t)$, and $y_3(t)$

(B) $y_2(t)$ and $y_2(t)$

(C) $y_2(t)$ and $y_3(t)$

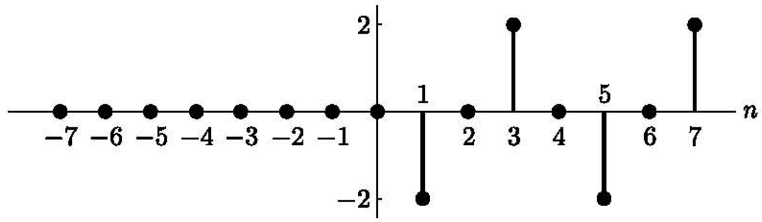
(D) $y_3(t)$ and $y_2(t)$

Q.41 For a discrete periodic signal $x[n]$ with period $N = 8$ and Fourier coefficients a_k it is given that

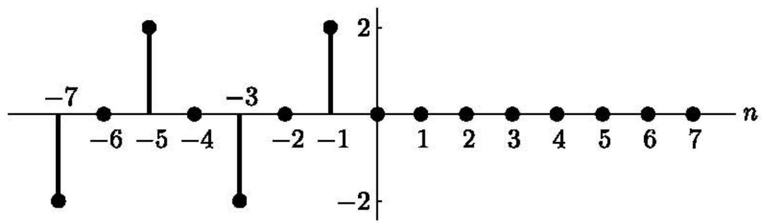
1. $a_k = - a_{k \quad 4}$
2. $x[2n+1] = (-1)^n$

The signal $x[n]$ is

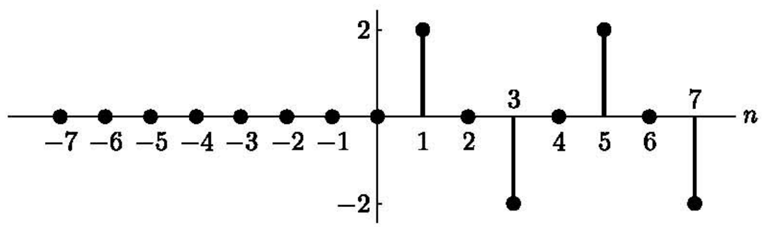
(A)



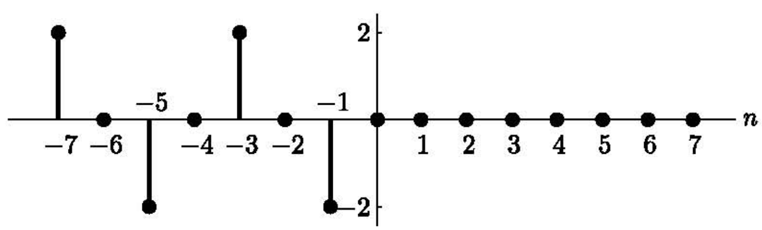
(B)



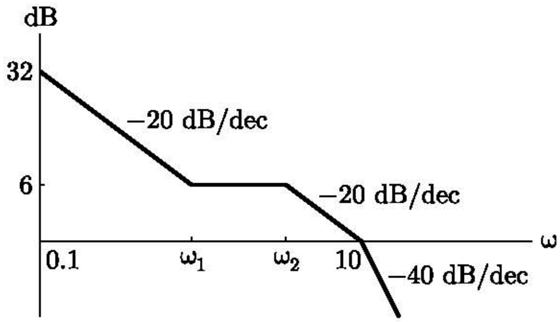
(C)



(D)



Q.42 Consider the asymptotic Bode plot of a minimum phase linear system in fig. The transfer function is



(A) $\dfrac{8s(s+2)}{(s+5)(s+10)}$

(B) $\dfrac{4(s+5)}{(s+2)(s+10)}$

(C) $\dfrac{4(s+2)}{s(s+5)(s+10)}$

(D) $\dfrac{8s(s+5)}{(s+2)(s+10)}$

Q.43 A DSB-SC signal is to be generated with a carrier frequency $f_c = 1$ MHz using a non-linear device with the input-output characteristic $v_o = a_0 v_i + a_1 v_i^3$ where a_0 and a_1 are constants. The output of the non-linear device can be filtered by an appropriate band-pass filter. Let $v_i = A_c^{'}\cos(2\pi f_c^{'} t) + m(t)$ where $m(t)$ is the message signal. Then the value of $f_c^{'}$ (in MHz) is

(A) 1.0

(B) 0.333

(C) 0.5

(D) 3.0

Q.44 If $z = z(u, v), u = x^2 - 2xy - y^2, v = a$, then

(A) $(x+y)\dfrac{\partial z}{\partial x} = (x-y)\dfrac{\partial z}{\partial y}$

(B) $(x-y)\dfrac{\partial z}{\partial x} = (x+y)\dfrac{\partial z}{\partial y}$

(C) $(x+y)\dfrac{\partial z}{\partial x} = (y-x)\dfrac{\partial z}{\partial y}$

(D) $(y-x)\dfrac{\partial z}{\partial x} = (x+y)\dfrac{\partial z}{\partial y}$

Q.45 The solution of the differential equation $xdy - ydx = \sqrt{x^2 + y^2}\,dx$ is given by

(A) $y = \dfrac{c_1}{x} + \sqrt{x^2 - y^2}$

(B) $y = c_2 x^2 - \sqrt{x^2 + y^2}$

(C) $y = \dfrac{c_3}{x^2} + \dfrac{1}{\sqrt{x^2 + y^2}}$

(D) $y = \dfrac{c_4}{x} - \dfrac{1}{\sqrt{x^2 - y^2}}$

Q.46 $\displaystyle\int_c \frac{1-2z}{z(z-1)(z-2)}dz = ?$ where c is the circle $|z| = 15$

(A) $2 + i6\pi$

(B) $4 + i3\pi$

(C) $1 + i\pi$

(D) $i3\pi$

Q.47 If the sum of mean and variance of a binomial distribution is 4.8 for five trials, the distribution is

(A) $\left(\frac{1}{5} + \frac{4}{5}\right)^5$

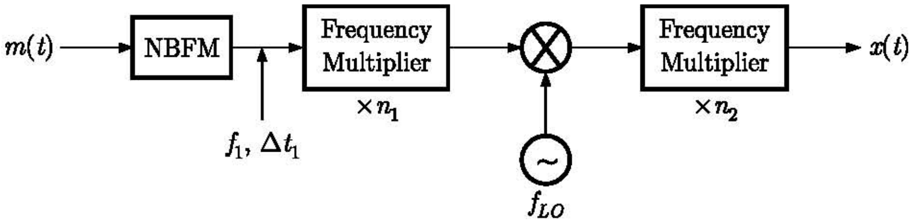
(B) $\left(\frac{1}{3} + \frac{2}{3}\right)^5$

(C) $\left(\frac{2}{5} + \frac{3}{5}\right)^5$

(D) None of these

Common Data for 48-49 :

A block diagram of an Armstrong FM transmitter is shown in fig. The parameter are as follows : $f_1 = 200$ kHz, $f_{LO} = 10.8$ MHz. $\Delta f_1 = 25$ Hz, $n_1 = 64$, $n_2 = 48$



Q.48 The maximum frequency deviation at the output of the FM transmitter is

(A) 100.6 kHz
(B) 76.8 kHz
(C) 43.2 kHz
(D) None of the above

Q.49 At output of the transmitter the carrier frequency is 5

(A) 96 MHz
(B) 12.8 MHz
(C) 48 MHz
(D) 132.4 MHz

Common Data for Q. 50-51

A 50 Ω, 8.4 m long lossless line operates at 150 MHz. The input impedance at the middle of the line is $80 - j60\,\Omega$. The phase velocity is $0.8c$.

Q.50 The input impedance at the generator is

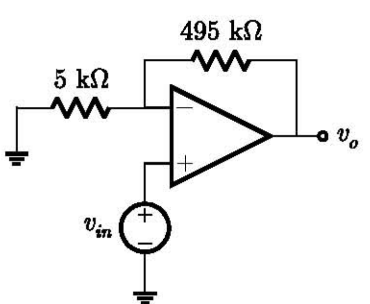
(A) $40.3 + j38.4\,\Omega$
(B) $21.6 - j20.3\,\Omega$
(C) $43.2 - j40.3\,\Omega$
(D) $80.3 + j76.8\,\Omega$

Q.51 The voltage reflection coefficient at the load is

(A) $0.468\angle -6.34^\circ$
(B) $0.468\angle 6.34^\circ$
(C) $0.468\angle -38.66^\circ$
(D) $0.468\angle 51.34^\circ$

Common Data Q. 52-53 :

Consider an op-amp circuit shown in figure below



Q.52 If open loop gain of op-amp is $A_{ol} = 10^5$, then closed loop gain A_{CL} is

(A) 100 (B) 99.90

(C) 98.90 (D) 99

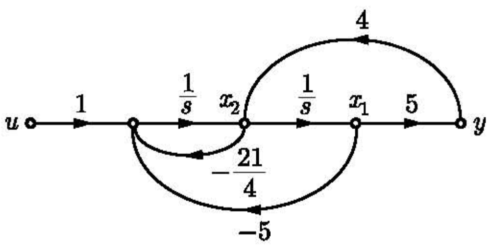
Q.53 If open loop gain decreases by 100%, then change in closed loop gain will be

(A) 0.99% (B) 0.01%

(C) 1.01% (D) 10%

Common Data Q. 54-55:

A state flow graph is shown below



Q.54 The state and output equation for this system is

(A) $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & -1 \\ 5 & \frac{21}{4} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u,\ y = \begin{bmatrix} 5 & 4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

(B) $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -5 & -\frac{21}{4} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 0 \\ 1 \end{bmatrix}u,\ y = \begin{bmatrix} 5 & 4 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

(C) $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -5 & -\frac{21}{4} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix}u,\ y = \begin{bmatrix} 4 & 5 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

(D) $\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} 0 & 1 \\ -5 & -\frac{21}{4} \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} 1 \\ 1 \end{bmatrix}u,\ y = \begin{bmatrix} 4 & 5 \end{bmatrix}\begin{bmatrix} x_1 \\ x_2 \end{bmatrix}$

Q.55 The system is

(A) Observable and controllable (B) Controllable only

(C) Observable only (D) None of the above