PAPER -3

Questions Q1. to Q20. carry one mark each.

Q1. If $-1, 2, 3$ are the eigen values of a square matrix $\mathbf{A}$ then the eigen values of $\mathbf{A}^2$ are

(A) $-1, 2, 3$

(B) 1, 4, 9

(C) 1, 2, 3

(D) None of these

Q2. If $z = xyf\left(\frac{y}{x}\right)$, then $x\frac{\partial z}{\partial x} + y\frac{\partial z}{\partial y}$ is equal to

(A) z

(B) $2z$

(C) xz

(D) yz

Q3. The z-transform of $x[n] = \delta[n+k], k > 0$ is

(A) z^{-k} , $z \neq 0$

(B) z^{k} , $z \neq 0$

(C) z^{-k} , all z

(D) z^{k} , all z

Q4. The fourier series of the signal shown in fig Q4 is

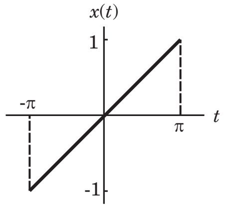


Fig Q4

(A) $\frac{2}{\pi}(\cos t + \frac{1}{2}\cos 2t + \frac{1}{3}\cos 3t + \frac{1}{4}\cos 4t + ...)$

(B) $\frac{2}{\pi}(\sin t - \frac{1}{2}\sin 2t + \frac{1}{3}\sin 3t - \frac{1}{4}\sin 4t + ...)$

(C) $\frac{2}{\pi}(\sin t + \cos t - \frac{1}{2}\sin 2t - \frac{1}{2}\cos 2t + \frac{1}{3}\sin 3t + ...)$

(D) $\frac{2}{\pi}(\sin t + \cos t + \frac{1}{3}\sin 3t + \frac{1}{3}\cos 3t + \frac{1}{5}\sin 5t + ...)$

Q5. In the circuit of fig Q5 the value of C_{eq} is

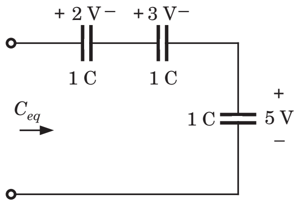


Fig Q5

(A) 10 F

(B) 3 F

(C) 1 F

(D) 0.1 F

Q6. The current in a 10 mH inductor is $i(t) = 2\sin 377t$ A. The voltage across inductor is

(A) $-7.54\cos 377t$ V

(B) $7.54\cos 377t$ V

(C) $0.53\cos 377t$ V

(D) $-0.53\cos 377t$ V

Q7. Consider the following two statements

S_1 : The dielectric isolation method is superior to junction isolation method.

S_2 : The beam lead isolation method is inferior to junction isolation method.

The true statements is (are)

(A) S_1 , S_2

(B) only S_1

(C) only S_2

(D) Neither S_1 nor S_2

Q8. For the circuit shown in fig. Q8, the minimum number and the maximum number of isolation regions are respectively

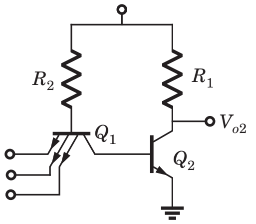


Fig Q8

(A) 2, 6

(B) 3, 6

(C) 2, 4

(D) 3, 4

Q9. In the circuit of fig Q9 the value of $A_v = \dfrac{v_o}{v_i}$ is

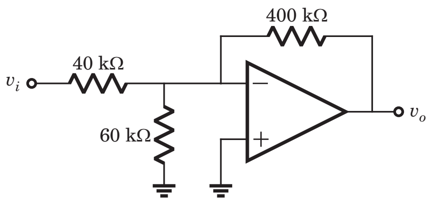


Fig Q9

(A) –10

(B) 10

(C) 13.46

(D) –13.46

Q10. The essential block of a phase lock loop (PLL) are phase detector, amplifier,

(A) high pass filter and crystal controlled oscillator
(B) low pass filter and crystal controlled oscillator
(C) high pass filter and voltage controlled oscillator
(D) low pass filter and voltage controlled oscillator

Q11. A 4 bit modulo–6 ripple counter uses *JK* flip-flop. If the propagation delay of each FF is 50 ns, the maximum clock frequency that can be used is equal to

(A) 5 MHz (B) 10 MHz

(C) 4 MHz (D) 20 MHz

Q12. A certain 8-bit successive-approximation convertor has 2.65 V full scale. The conversion time for $V_A = 1.5$ V is 75 μs. The conversion time for $V_A = 2$ V would be

(A) 75 μs (B) 100 μs

(C) 225 μs (D) None of the above

Q13. Consider the following signal

$x(t) = \cos \pi t + 2\cos 3\pi t + 3\cos 5\pi t,\ \ y(t) = \sin t + 6\cos 2\pi t,\ \ z(t) = \sin 3t \cos 4t$

Periodic signal are

(A) $x(t)$ and $y(t)$ (B) $y(t)$ and $z(t)$

(C) $x(t)$ and $z(t)$ (D) All

Q14. The energy of signal $A\delta[n]$ is

(A) A^2 (B) $\frac{A^2}{2}$

(C) $\frac{A^2}{4}$ (D) 0

Q15. The correct sequence of steps needed to improve system stability is

(A) reduce gain, use negative feedback, insert derivative action
(B) reduce gain, insert derivative action, use negative feedback
(C) insert derivative action, use negative feedback, reduce gain
(D) use negative feedback, reduce gain, insert derivative action.

Q16. In a derivative error compensation

(A) damping decreases and setting time decreases
(B) damping increases and setting time increases
(C) damping decreases and setting time increases
(D) damping increases and setting time decreases

Q17. **Assertion (A):** The channel capacity of an infinite bandwidth channel is finite.
Reason (R): Signal power is limited but noise power is not.

Choose correct option:
(A) Both A and R individually true and R is the correct explanation of A.
(B) Both A and R individually true and but R is not the correct explanation of A.
(C) A is true but R is false
(D) A is false

Q18. Consider the List I (coding technique in digital communication system)and List II (purpose)

List I	**List II**
P. Huffman Code	1. Elimination of redundancy
Q. Error correcting code	2. Reduces bit rate
R. NRZ coding	3. Adapts the transmitted signal to the line
S. Delta Modulation	4. Channel coding

The correct match is

	P	Q	R	S
(A)	1	2	3	4
(B)	3	4	1	2
(C)	1	4	3	2
(D)	3	2	1	4

Q19. Indicate which one of the following will not exist in a rectangular resonant cavity.

(A) TE_{110}
(B) TE_{011}
(C) TM_{110}
(D) TM_{111}

Q20. An antenna has directivity of 100 and operates at 150 MHz. The maximum effective aperture is

(A) $31.8\,\mathrm{m}^2$
(B) $62.4\,\mathrm{m}^2$
(C) $26.4\,\mathrm{m}^2$
(D) $13.2\,\mathrm{m}^2$

Questions Q21. to Q75. carry two marks each.

Q21. The system of equation $x - 2y + z = 0$, $2x - y + 3z = 0$, $\lambda x + y - z = 0$ has the trivial solution as the only solution, if λ is

(A) $\lambda \neq \frac{-4}{5}$

(B) $\lambda = \frac{4}{3}$

(C) $\lambda \neq 2$

(D) None of these

Q22. $f(x) = 2x^3 - 15x^2 + 36x + 1$ is increasing in the interval

(A)] 2, 3 [

(B)] $-\infty$, 3 [

(C)] $-\infty$, 2 [$\cup$] 3, ∞

(D) None of these

Q23. $\int_{-1}^{1} \int_{0}^{z} \int_{x-z}^{x+z} (x + y + z)\, dy\, dx\, dz$ is equal to

(A) 4

(B) –4

(C) 0

(D) None of these

Q24. Let $(y - c)^2 = cx$ be the primitive of the differential equation

$$4x\left(\frac{dy}{dx}\right)^2 + 2x\left(\frac{dy}{dx}\right) - y = 0$$

The number of integral curves which will pass through (1, 2) is

(A) One

(B) Two

(C) Three

(D) Four

Q25. If $u = \sinh x \cos y$ then the analytic function $f(z) = u + jv$ is

(A) $\cosh^{-1} z + ic$

(B) $\cosh z + ic$

(C) $\sinh z + ic$

(D) $\sinh^{-1} z + ic$

Q26. The equations of the two lines of regression are : $4x + 3y + 7 = 0$ and $3x + 4y = 8 = 0$. The correlation coefficient between x and y is

(A) 1.25

(B) 0.25

(C) –0.75

(D) 0.92

Q27. For $dy/dx = x + y$ given that $y = 1$ at $x = 0$. Using Runge Kutta fourth order method the value of y at $x = 0.2$ is $(h = 0.2)$

(A) 1.1384

(B) 1.9438

(C) 1.2428

(D) 1.6389

Q28. Consider three different signal

$$x_1\,[n]=\left[2^n-\left(\frac{1}{2}\right)^n\right]u[n],\quad x_2[n]=-2^n\,u[-n-1]+\frac{1}{2^n}\,u[-n-1],\quad x_3[n]=-2^n\,u[-n-1]-\frac{1}{2^n}\,u[n]$$

Fig. Q28 shows the three different region.

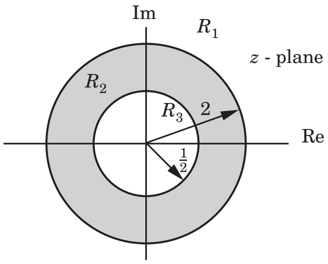


Fig Q28

Choose the correct option for the ROC of signal

	R_1	R_2	R_3
(A)	$x_1[n]$	$x_2[n]$	$x_3[n]$
(B)	$x_2[n]$	$x_3[n]$	$x_1[n]$
(C)	$x_1[n]$	$x_3[n]$	$x_2[n]$
(D)	$x_3[n]$	$x_2[n]$	$x_1[n]$

Q29. The Fourier transform of the signal $x(t)$ as shown in fig. Q29 is

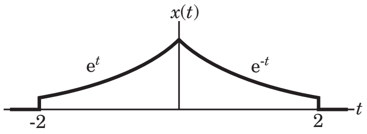


Fig Q29

(A) $2-2e^{-2}\sin 2\omega+2\omega e^{-2}\sin 2\omega$

(B) $2+2e^{-2}\cos 2\omega-2\omega e^{-2}\cos 2\omega$

(C) $\dfrac{2-2e^{-2}\cos 2\omega+2\omega e^{-2}\sin 2\omega}{1+\omega^2}$

(D) $\dfrac{2+2e^{-2}\cos 2\omega-2\omega e^{-2}\sin 2\omega}{1+\omega^2}$

Q30. For the circuit of Fig. Q30 the value of v_s , that will result in $v_1 = 0$, is

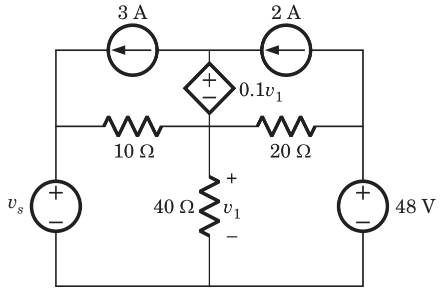


Fig Q30

(A) 28 V

(B) –28 V

(C) 14 V

(D) –14 V

Q31. In the circuit of fig Q31 the value of i_1 will be

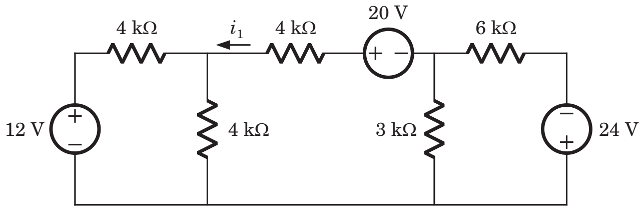


Fig Q31

(A) 3 A

(B) 0.75 mA

(C) 2 mA

(D) 1.75 mA

Q32. The network of fig. Q32 reaches a steady state with the switch closed. At $t = 0$ switch is opened. For $t \geq 0$, $v_o(t)$ is

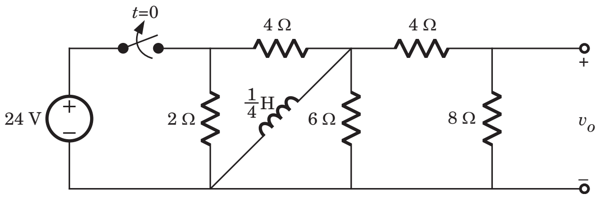


Fig Q32

(A) $9.6e^{-9.6t}$ V

(B) $-9.6e^{-9.6t}$ V

(C) $2.4e^{-2.4t}$ V

(D) $-2.4e^{-2.4t}$ V

Q33. In the circuit of fig Q33 the value of V_x will be

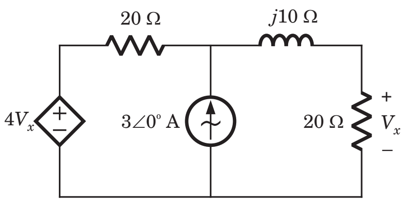


Fig Q33

(A) $29.11\angle 166°$ V

(B) $29.11\angle -166°$ V

(C) $43.24\angle 124°$ V

(D) $43.24\angle -124°$ V

Q34. The initial condition at $t = 0^-$ of a switched capacitor circuit are shown in Fig. Q34. Switch S_1 and S_2 are closed at $t = 0$. The voltage $v_a(t)$ for $t > 0$ is

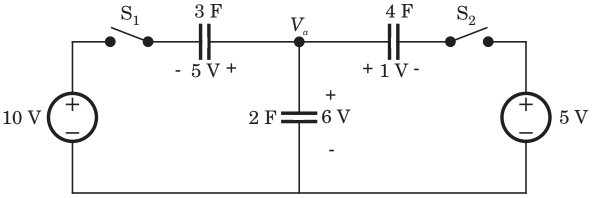


Fig Q34

(A) $\frac{9}{t}$ V

(B) $9e^{-t}$ V

(C) 9 V

(D) 0 V

Q35. The Thevenin equivalent at terminal *ab* for the network shown in fig. Q35 is

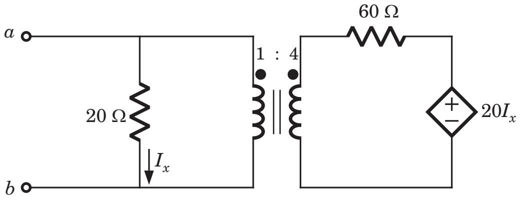


Fig Q35

(A) 6 V, 10 Ω

(B) 6 V, 4 Ω

(C) 0 V, 4 Ω

(D) 0 V, 10 Ω

Q36. The circuit shown in fig. Q36 is reciprocal if a is

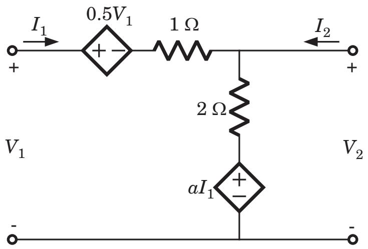


Fig Q36

(A) 2 (B) –2

(C) 1 (D) –1

Q37. In germanium ($n_i = 2.4\times10^{13}\ \text{cm}^{-3}$) at $T = 300\,\text{K}$, the donor concentration are $N_d = 10^{14}\ \text{cm}^{-3}$ and $N_a = 0$. The Fermi energy level with respect to intrinsic Fermi level is

(A) 0.04 eV (B) 0.08 eV

(C) 0.42 eV (D) 0.86 eV

Q38. Two ideal *pn* junction have exactly the same electrical and physical parameters except for the band gap of the semiconductor materials. The first has a bandgap energy of 0.525 eV and a forward-bias current of 10 mA with $V_a = 0.255\,\text{V}$. The second *pn* junction diode is to be designed such that the diode current $I = 10\,\mu\text{A}$ at a forward-bias voltage of $V_a = 0.32\,\text{V}$. The bandgap energy of second diode would be

(A) 0.77 eV

(B) 0.67 eV

(C) 0.57 eV

(D) 0.47 eV

Q39. Consider the circuit shown in fig Q39. If $V_s = 0.63\,\text{V}$, $I_1 = 275\,\mu\text{A}$ and $I_2 = 125\,\mu\text{A}$, then the value of I_3 is

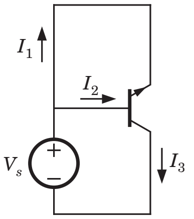


Fig Q39

(A) $-400\,\mu\text{A}$ (B) $400\,\mu\text{A}$

(C) $-600\,\mu\text{A}$ (D) $600\,\mu\text{A}$

Q40. The parameters of $n-$channel depletion mode MOSFET are $V_{TN} = -2$ V and $k'_n = 80\,\mu\text{A}/\text{V}^2$. The drain current is $I_D = 1.5$ mA at $v_{GS} = 0$ and $V_{DS} = 3$ V. The ratio W/L is

(A) 7.78 mA (B) 15.56 mA

(C) 9.375 mA (D) 4.69 mA

Q41. For a particular NMOS device the parameters are $V_{TN} = 1$ V, $L = 2.4\,\mu$m, $\mu_n = 600$ cm^2/V $-$ s and $t_{ox} = 400$ A°. When device is biased in the saturation region at $V_{GS} = 5$ V, the drain current is $I_D = 1.2$ mA. The channel width of device is

(A) 7.21 μm (B) 10.46 μm

(C) 5.23 μm (D) 20.92 μm

Q42. In the series voltage regulator circuit of fig. Q42 $V_{BE} = 0.7$ V, $\beta = 50$, $V_Z = 8.3$ V. The output voltage V_o is

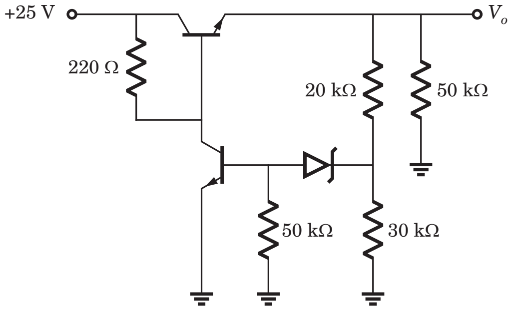


Fig Q42

(A) 25 V (B) 25.7 V

(C) 15 V (D) 15.7 V

Q43. For the circuit in fig. q43 the transistor parameters are $V_p = -3.5$ V, $I_{DSS} = 18$ mA, and $\lambda = 0$. The value of V_{DS} is

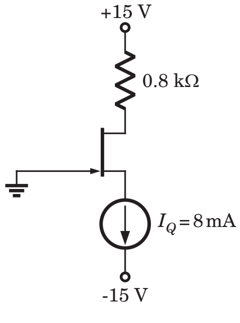


Fig Q43

(A) 7.43 V (B) 8.6 V

(C) –1.17 V (D) 1.17 V

Q44. Consider the NMOS common-gate circuit of fig. Q44. The parameter are $g_m = 2$ mS and $r_o = \infty$. The voltage gain A_v is

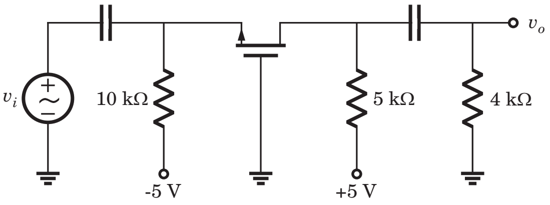


Fig Q44

(A) 4.44 (B) –4.44

(C) 2.22 (D) –2.22

Q45. For the circuit shown in fig. Q45 the true relation is

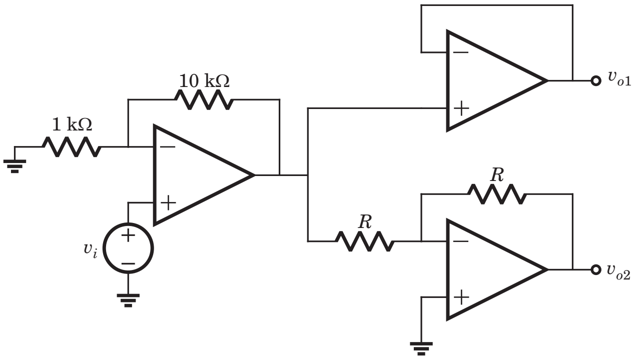


Fig Q45

(A) $v_{o1} = v_{o2}$ (B) $v_{o1} = -v_{o2}$

(C) $v_o = 2v_{o2}$ (D) $2v_{o1} = v_{o2}$

Q46. In the circuit of fig. Q46 the voltage v_{i1} is $(1+2\sin\omega t)$ mV and $v_{i2} = -10$ mV. The output voltage v_o is

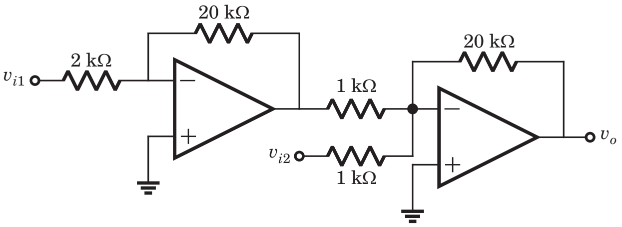


Fig Q46

(A) $-0.4(1+\sin\omega t)$ mV (B) $0.4(1+\sin\omega t)$ mV

(C) $0.4(1+2\sin\omega t)$ mV (D) $-0.4(1+2\sin\omega t)$ mV

Q47. A 7 bit Hamming code groups consisting of 4 information bits and 3 parity bits is transmitted. The group 1101100 is received in which at most a single error has occurred. The transmitted code is

(A) 1111100

(B) 1100100

(C) 1001100

(D) 1101000

Q48. The 4–to–1 multiplexer shown in fig. Q48 implements the Boolean expression

$$f(w,x,y,z)=\Sigma m(4,5,7,8,10,12,15)$$

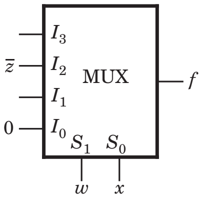


Fig Q48

The input to I_1 and I_3 will be

(A) $y\bar{z}$, $\bar{y}+\bar{z}$

(B) $\bar{y}+z$, $y \odot z$

(C) $\bar{y}+z$, $y \oplus z$

(D) $x+\bar{y}$, $y \oplus z$

Q49. Consider the RTL gate of fig. Q49. The transistor parameters are $V_{CE\,(sat)}=0.2\,\text{V}$ and $\beta=50$. The logic HIGH voltage is $V_H=3.5$ V. If input drive the similar type of gate, the fanout is

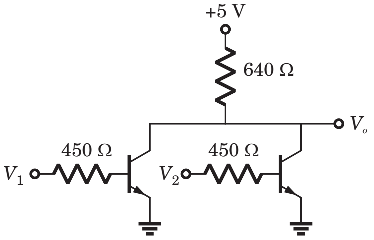


Fig Q49

(A) 5

(B) 10

(C) 15

(D) 20

Q50. Consider the following instruction to be executed by a 8085 µp. The input port has an address of 01H and has a data 05H to input:

```
IN        01H
ANI       80H
```

After execution of the two instruction the contents of flag register are

(A)

1	0	×	1	×	1	×	0

(B)

0	1	×	0	×	1	×	0

(C)

0	1	×	1	×	1	×	0

(D)

0	1	×	1	×	0	×	0

Q51. It is desired to mask is the high order bits $(D_7 - D_4)$ of the data bytes in register C of µP. Consider the following set of instruction

(a)

```
MOV       A, C
ANI       F0H
MOV       C, A
HLT
```

(b)

```
MOV       A, C
MVI       B, F0H
ANA       B
MOV       C, A
HLT
```

(c)

```
MOV       A, C
MVI       B, 0FH
ANA       B
MOV       C, A
HLT
```

(d)

```
MOV       A, C
ANI       0FH
MOV       C, A
HLT
```

The instruction set, which execute the desired operation are

(A) a and b

(B) c and d

(C) only a

(D) only d

Q52. Consider the cascade of the following two system S_1 and S_2 , as shown in fig. Q51

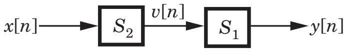


Fig Q52

S_1 : Causal LTI $v[n] = \frac{1}{2}v[n-1] + x[n]$

S_2 : Causal LTI $y[n] = ay[n-1] + bv[n]$

The difference equation for cascaded system is

$$y[n] = -\frac{1}{8}y[n-2] + \frac{3}{4}y[n-1] + x[n]$$

The value of a is

(A) $\frac{1}{4}$

(B) 1

(C) 4

(D) 2

Q53. The system diagram for the transfer function $H(z) = \frac{z}{z^2 + z + 1}$ is shown in fig. Q53. This system diagram is a

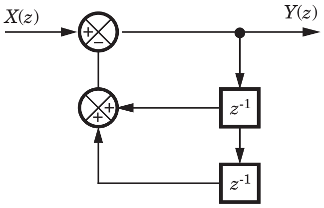


Fig Q53

(A) Correct solution

(B) Not correct solution

(C) Correct and unique solution

(D) Correct but not unique solution

Q54. The frequency response of a causal and stable LTI system is $H(j\omega) = \frac{1 - j\omega}{1 + j\omega}$. The group delay of the system is

(A) $\frac{2}{1+\omega^2}$

(B) $\frac{-2}{1+\omega^2}$

(C) $2\tan^{-1}\omega$

(D) $-2\tan^{-1}\omega$

Q55. Consider a periodic signal $x(t)$ whose Fourier series coefficients are

$$X[k] = \begin{cases} 2, & k = 0 \\ j\left(\frac{1}{2}\right)^{|k|}, & \text{otherwise} \end{cases}$$

Consider the statements

1. $x(t)$ is real 2. $x(t)$ is even. 3. $\frac{dx(t)}{dt}$ is even

The true statements are

(A) 1 and 2 (B) only 2

(C) only 1 (D) 1 and 3

Q56. A real and odd periodic signal $x[n]$ has fundamental period $N = 7$ and FS coefficients $X[k]$. Given that $X[15] = j$, $X[16] = 2j$, $X[17] = 3j$. The values of $X[0]$, $X[-1]$, $X[-2]$, and $X[-3]$ will be

(A) $0,\ j,\ 2j,\ 3j$

(B) 1, 1, 2, 3

(C) 1, –1, –2, –3

(D) $0,\ -j,\ -2j,\ -3j$

Q57. For the block diagram shown in fig. Q57 the numerator of transfer function is

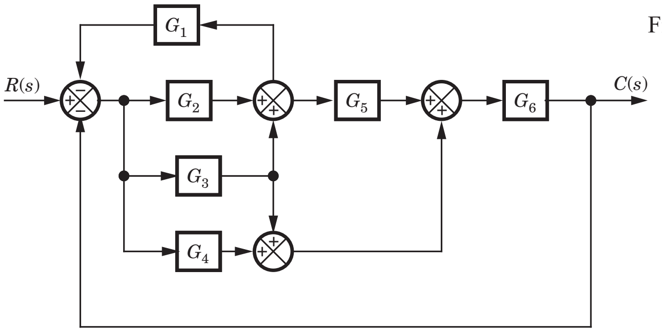


Fig Q57

(A) $G_6[G_4 + G_3 + G_5(G_3 + G_2)]$

(B) $G_6[G_2 + G_3 + G_5(G_3 + G_4)]$

(C) $G_6[G_1 + G_2 + G_3(G_4 + G_5)]$

(D) None of the above

Q58. A second order system with no zeros has its poles located at $-3+j4$ and $-3-j4$ in the s-plane. The undamped natural frequency and the damping ratio of the system are respectively

(A) 5 rad/s and 0.60

(B) 3 rad/s and 0.60

(C) 5 rad/s and 0.80

(D) 3 rad/s and 0.80

Q59. The characteristic equation of a feedback control system is given by $(s^2+4s+4)(s^2+11s+30)+Ks^2+4K=0$ where $K>0$. In the root locus of this system, the asymptotes meet in s-plane at

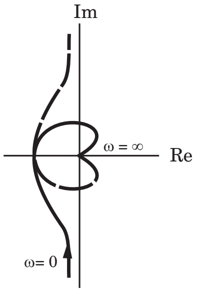
(A) (–9.5, 0)

(B) (–5.5, 0)

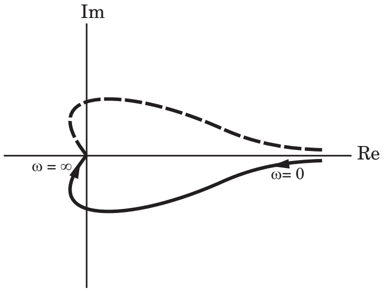
(C) (–7.5, 0)

(D) None of the above

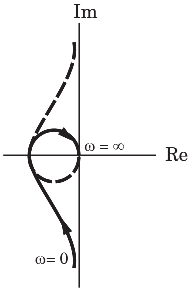
Q60. For the certain unity feedback system $G(s)=\dfrac{K}{s(s+1)(2s+1)(3s+1)}$ the Nyquist plot is



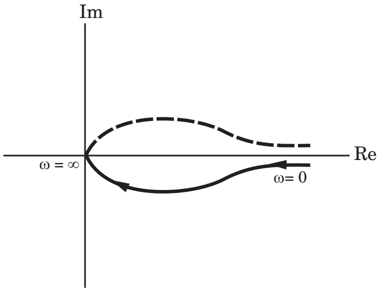
(A)



(B)



(C)



(D)

Q61. A state-space representation of a system is given by

$$\dot{\mathbf{x}} = \begin{bmatrix} 0 & 1 \\ -2 & 0 \end{bmatrix}\mathbf{x},\ y = [1 \quad -1]\mathbf{x},\ \text{and } \mathbf{x}(0) = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

The time response of this system will be

(A) $\sin\sqrt{2}t$

(B) $\frac{3}{\sqrt{2}}\sin\sqrt{2}t$

(C) $-\frac{1}{\sqrt{2}}\sin\sqrt{2}t$

(D) $\sqrt{3}\sin\sqrt{2}t$

Q62. A signal process $m(t)$ is mixed with a channel noise $n(t)$. The power spectral density are as follows

$$S_m(\omega) = \frac{6}{9+\omega^2},\ S_n(\omega) = 6$$

The optimum Wiener-Hopf filter is

(A) $\frac{\omega^2+9}{\omega^2+10}$

(B) $\frac{1}{\omega^2+10}$

(C) $\frac{\omega^2+10}{\omega^2+9}$

(D) None of the above

Q63. A mixer stage has a noise figure of 20 dB. This mixer stage is preceded by an amplifier which has a noise figure of 9 dB and an available power gain of 15 dB. The overall noise figure referred to the input is

(A) 11.07

(B) 18.23

(C) 56.48

(D) 97.38

Q64. An FM modulator has output $x_c(t) = 200\cos\left(\omega_c t + 2\pi k_f \int_0^t m(\tau)\,d\tau\right)$ where $k_f = 30\,\text{Hz/V}$. The $m(t)$ is the rectangular pulse $m(t) = 8\Pi\left(\frac{1}{4}(t-2)\right)$. The frequency deviation would be

(A) $240u(t) - 720u(t-4)$

(B) $240u(t) + 720u(t-4)$

(C) $240u(t) - 80u(t-4)$

(D) $240(u(t) - u(t-4))$

Q65. Consider a set of 10 signals $x_i(t), i=1,2,3,\ldots 10$. Each signal is band limited to 1 kHz. All 10 signals are to be time-division multiplexed after each is multiplied by a carrier $c(t)$ shown in fig. Q65.

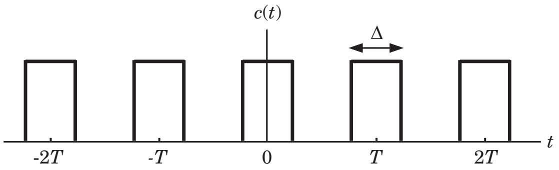


Fig Q65

If the period T of $c(t)$ is chosen to have the maximum allowable value, the largest value of Δ would be

(A) 5×10^{-3} sec

(B) 5×10^{-4} sec

(C) 5×10^{-5} sec

(D) 5×10^{-6} sec

Q66. A linear delta modulator is designed to operate on speech signals limited to 3.4 kHz. The sampling rate is 10 time the Nyquist rate of the speech signal. The step size δ is 100 mV. The modulator is tested with a 1 kHz sinusoidal signal. The maximum amplitude of this test signal required to avoid slope overload is

(A) 2.04 V

(B) 1.08 V

(C) 4.08 V

(D) 2.16 V

Q67. If $V = xy - x^2 y + y^2 z^2$, the value of the **div grad** $\boldsymbol{V}$ is

(A) 0

(B) $z + x^2 + 2y^2 z$

(C) $2y(z^2 - yz - x)$

(D) $2(z^2 - y^2 - y)$

Q68. A uniform plane wave in air with $\mathbf{H} = 6\sin(\omega t - 5x)\,\mathbf{u}_y$ A/m is normally incident on a plastic region $(\sigma = 0,\ \mu_r = 1,\ \varepsilon_r = 4)$. The reflection coefficient is

(A) $-\frac{1}{3}$

(B) $\frac{1}{3}$

(C) $-\frac{1}{6}$

(D) $\frac{1}{6}$

Q69. Two identical antennas, each of input impedance 74 Ω are fed with three identical 50 Ω quarter-wave lossless transmission lines as shown in fig. Q69. The input impedance at the source end is

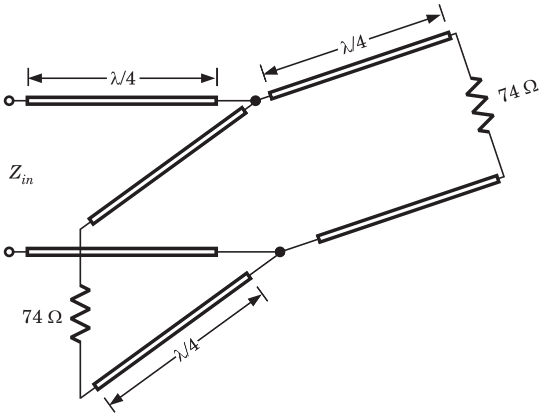


Fig Q69

(A) 148 Ω (B) 106 Ω

(C) 74 Ω (D) 53 Ω

Q70. A parallel-plate guide operates in the *TEM* mode only over the frequency range $0 < f < 3$ GHz. The dielectric between the plates is teflon ($\varepsilon_r = 2.1$). The maximum allowable plate separation *b* is

(A) 3.4 cm (B) 6.8 cm

(C) 4.3 cm (D) 8.6 cm

Common Data Questions

Common Data for Questions Q.71-73:

Consider the region defined by $|x|, |y|$ and $|z| < 1$. Let $\varepsilon = 5\varepsilon_o$, $\mu = 4\mu_o$, and $\sigma = 0$ the displacement current density $\mathbf{J}_d = 20\cos(1.5\times10^8 t - ax)\,\mathbf{u}_y\ \mu\mathrm{A/m}^2$. Assume no DC fields are present.

Q71. The electric field intensity $\mathbf{E}$ is

(A) $6\sin(1.5\times10^8 t - ax)\,\mathbf{u}_y$ mV/m

(B) $6\cos(1.5\times10^8 t - ax)\,\mathbf{u}_y$ mV/m

(C) $3\cos(1.5\times10^8 t - ax)\,\mathbf{u}_y$ mV/m

(D) $3\sin(1.5\times10^8 t - ax)\,\mathbf{u}_y$ mV/m

Q72. The magnetic field intensity is

(A) $-4a\sin(1.5\times10^8 t - ax)\,\mathbf{u}_z$ μA/m

(B) $-4a\sin(1.5\times10^8 t - ax)\,\mathbf{u}_z$ mA/m

(C) $4a\sin(1.5\times10^8 t - ax)\,\mathbf{u}_z$ μA/m

(D) $4a\sin(1.5\times10^8 t - ax)\,\mathbf{u}_z$ mA/m

Q73. The value of a is

(A) 4.3 (B) 2.25

(C) 5 (D) 6

Common Data for Questions Q74-75:

Consider the system shown in fig. Q74-75. The average value of $m(t)$ is zero and maximum value of $|m(t)|$ is M. The square-law device is defined by $y(t) = 4x(t) + 10x^2(t)$

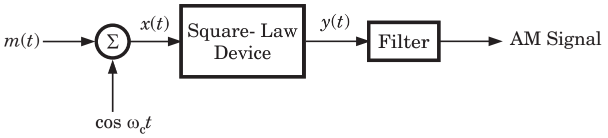


Fig Q74-75

Q74. The value of M, required to produce modulation index of 0.8, is

(A) 0.32 (B) 0.26

(C) 0.52 (D) 0.16

Q75. Let W be the BW of message signal $m(t)$. AM signal would be recovered if.

(A) $f_c > W$ (B) $f_c > 2W$

(C) $f_c > 3W$ (D) $f_c > 4W$

Linked Answer Questions: Q76. to Q85. carry two marks each.

Statement for Linked Answer Questions: Q76. and Q77:

Consider the circuit shown in fig. Q76-77. If voltage $V_s = 0.63$ V, the currents are $I_C = 275$ µA and $I_B = 5$ µA .

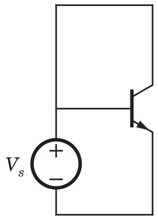


Fig Q76-77

Q76. The forward common-emitter gain β_F is

(A) 56 (B) 55

(C) 0.9821 (D) 0.9818

Q77. The forward current gain α_F is

(A) 0.9821

(B) 0.9818

(C) 55

(D) 56

Statement for Linked Answer Questions: Q78 and Q79:

The diode in the circuit of fig. Q78-79 has the non linear terminal characteristic as shown in fig. Let the voltage be $v_s = \cos \omega t$ V.

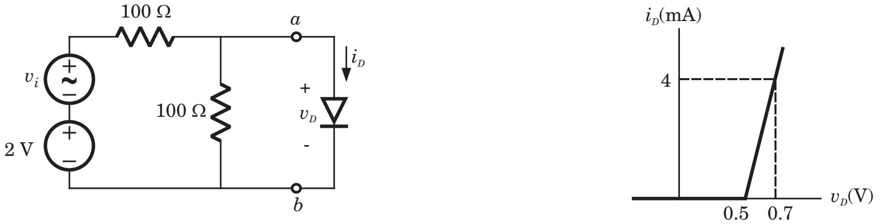


Fig Q78-79

Q78. The current i_D is

(A) $2.5(1+\cos \omega t)$ mA

(B) $5(0.5+\cos \omega t)$ mA

(C) $5(1+\cos \omega t)$ mA

(D) $5(1+0.5\cos \omega t)$ mA

Q79. The voltage v_D is

(A) $0.25(3+\cos \omega t)$ V

(B) $0.25(1+3\cos \omega t)$ V

(C) $0.5(3+1\cos \omega t)$ V

(D) $0.5(2+3\cos \omega t)$ V

Statement for Linked Answer Questions: Q80 and Q81:

For the Schmitt trigger oscillator of fig. Q80-81 saturation output voltage are +10 V and –5 V.

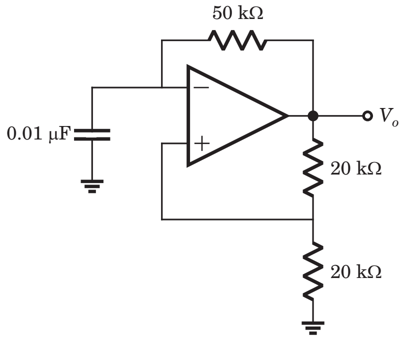


Fig Q80-81

Q80. The frequency of oscillation is

(A) 2183 Hz

(B) 869 Hz

(C) 1369 Hz

(D) 1443 Hz

Q81. The duty cycle is

(A) 60.2%

(B) 39.8%

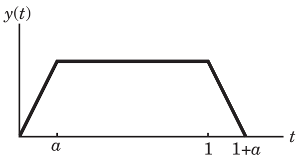
(C) 48.4%

(D) 51.6%

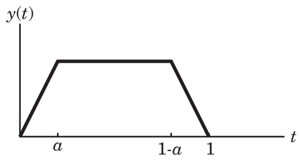
Statement for Linked Answer Questions: Q82 and Q83:

Suppose that $x(t) = \begin{cases} 1, & 0 \le t \le 1 \\ 0, & \text{elsewhere} \end{cases}$ and $h(t) = x\left(\frac{t}{a}\right)$, where $0 < a \le 1$.

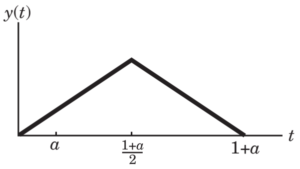
Q82. The $y(t) = x(t) * h(t)$ is



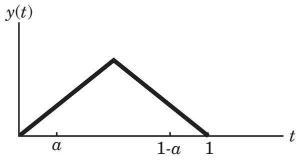
(A)



(B)



(C)



(D)

Q83. If $\dfrac{dy(t)}{dt}$ contains only three discontinuities, the value of a is

(A) 1

(B) 2

(C) 3

(D) 0

Statement for Linked Answer Questions: Q84 and Q85:

A feedback system is shown in fig. Q84-85.

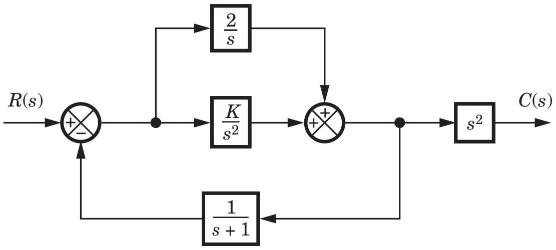


Fig Q84-85

Q84. The closed loop transfer function for this system is

(A) $\dfrac{2s^4 + (K+2)s^3 + Ks^2}{s^3 + s^2 + 2s + K}$

(B) $\dfrac{s^5 + s^4 + 2s^3 + (K+2)s^2 + (K+2)s + K}{s^3 + s^2 + 2s + K}$

(C) $\dfrac{s^3 + s^2 + 2s + K}{2s^4 + (K+2)\,s^3 + Ks^2}$

(D) $\dfrac{s^3 + s^2 + 2s + K}{s^5 + s^4 + 2s^3 + (K+2)s^2 + (K+2)s + K}$

Q85. The poles location for this system is shown in fig. Q85. The value of K is

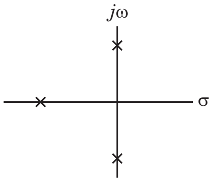


Fig Q85

(A) 4

(B) –4

(C) 2

(D) –2

Answers Paper-3

1. (B)	2. (B)	3. (D)	4. (B)	5. (D)
6. (A)	7. (B)	8. (D)	9. (A)	10. (D)
11. (A)	12. (A)	13. (C)	14. (A)	15. (D)
16. (D)	17. (A)	18. (B)	19. (A)	20. (A)
21. (A)	22. (C)	23. (C)	24. (B)	25. (C)
26. (C)	27. (C)	28. (C)	29. (C)	30. (D)
31. (B)	32. (B)	33. (B)	34. (C)	35. (C)
36. (A)	37. (A)	38. (A)	39. (B)	40. (C)
41. (A)	42. (C)	43. (A)	44. (A)	45. (B)
46. (B)	47. (C)	48. (B)	49. (C)	50. (C)
51. (B)	52. (A)	53. (D)	54. (A)	55. (B)
56. (D)	57. (A)	58. (A)	59. (C)	60. (A)
61. (B)	62. (B)	63. (A)	64. (D)	65. (C)
66. (B)	67. (D)	68. (A)	69. (A)	70. (A)
71. (D)	72. (C)	73. (B)	74. (D)	75. (C)
76. (B)	77. (A)	78. (C)	79. (A)	80. (B)
81. (B)	82. (A)	83. (A)	84. (A)	85. (C)

Problem

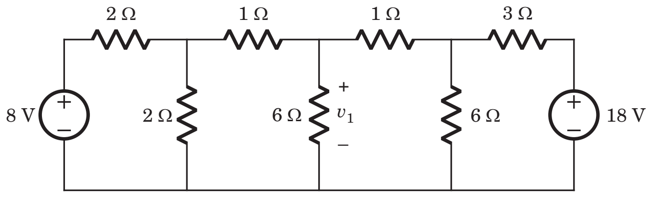


Fig. P.1.4.10

10. $v_1 = ?$

(A) 6 V

(B) 7 V

(C) 8 V

(D) 10 V

Solution

10. (A) By changing the LHS and RHS in Thevenin equivalent

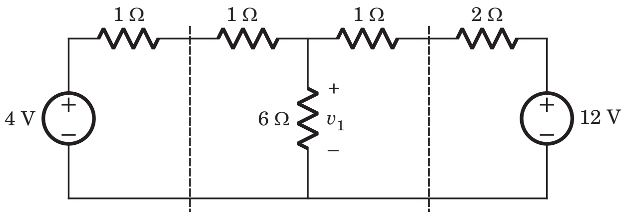


Fig. S1.4.10

$$v_1 = \frac{\dfrac{4}{1+1} + \dfrac{12}{1+2}}{\dfrac{1}{1+1} + \dfrac{1}{6} + \dfrac{1}{1+2}} = 6\text{ V}$$