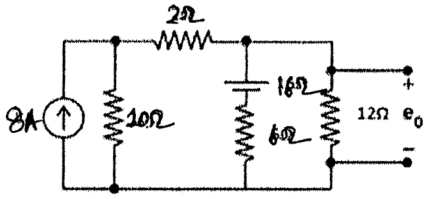
Ref. No. : Ex/ET/PC/B/T/212/2023

B.E. ELECTRONICS AND TELE-COMMUNICATION ENGINEERING SECOND YEAR FIRST SEMESTER – 2023

Subject : CIRCUIT ANALYSIS AND SYNTHESIS **Time : 3.0 hours** **Full Marks : 100**

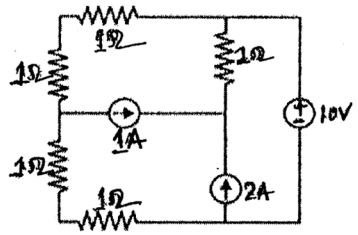
Answer any 50 questions. Each question carries 2 marks. Each incorrect answer will deduct 0.5 marks.

1. The voltage in e_0 in figure



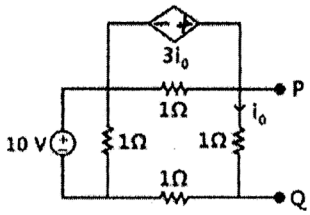
(a) 48V (b) 28V (c) 36V (d) 24V

2. In the circuit the power supplied by the voltage source is



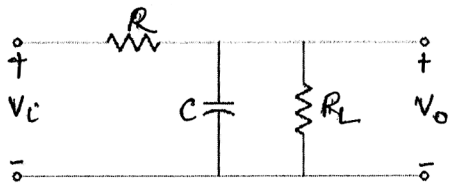
(a) 0W (b) 5W (c) 10W (d) 100W

3. The Thevenin equivalent resistance across PQ is



(a) 2Ω (b) -2 Ω (c) -1 Ω (d) 1 Ω

4. If the transfer function of the following network is $\frac{V_0(s)}{V_i(s)} = \frac{1}{2+sCR}$

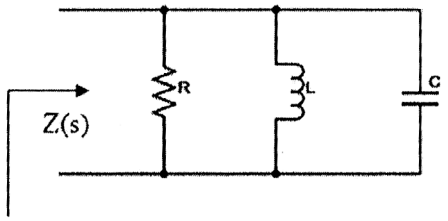


The value of the load resistance R_L is

(a) 2R (b) $\frac{R}{4}$ (c) $\frac{R}{2}$ (d) R

5. The driving point impedance of the following network is given by

$$Z(s) = \frac{0.2s}{s^2 + 0.1s + 2}$$

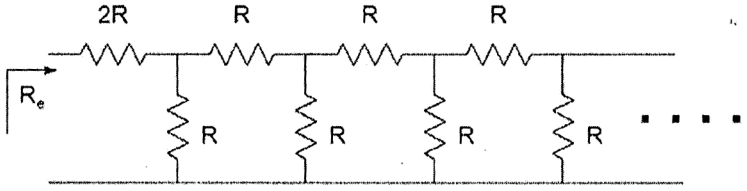


The component values are

(A) L = 5 H, R = 0.5 W, C = 0.1 F (B) L = 0.1 H, R = 0.5 W, C = 5 F

(C) L = 5 H, R = 2 W, C = 0.1F (D) L = 0.1 H, R = 2 W, C = 5F

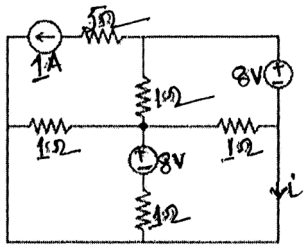
6. The equivalent resistance in the infinite ladder network shown in the figure, is



The value of $\frac{R_e}{R}$ is

(a) 2 (b) 4.618 (c) 4 (d) 2.618

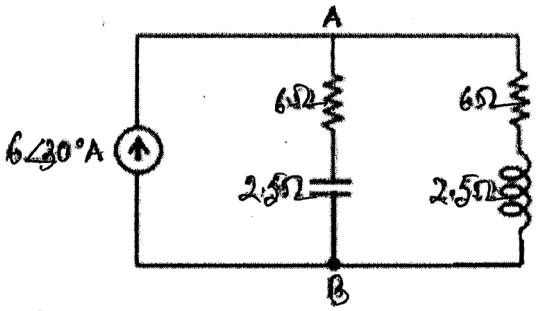
7. In the figure shown, the current i (in ampere) is



(a) (b) (c) (d)

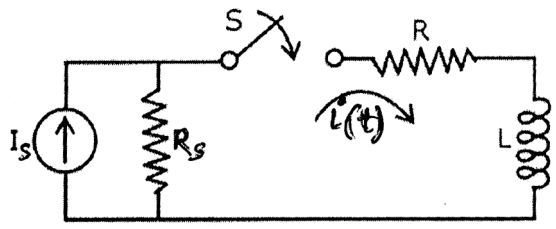
8. Given below is the current and applied voltage in a series connection of two pure circuit elements. $V = 150 \sin (314\,t + 10^\circ)$ volts $i = 15 \sin (314\,t + 53.4^\circ)$ amperes
The circuit contains a
(a) Resistance of 5 and capacitor of 1F (b) Resistance of 4.47 and inductor of 0.028 H
(c) Resistance of 6.7 and capacitor of 0.01 F (d) Resistance of 10 and inductor of 0.021 H

9. In the AC network shown in the figure. The phasor voltage V_{AB} (in volts) is



(a) $7\angle 30^\circ$ (b) $6\angle 30^\circ$ (c) $21\angle 30^\circ$ (d) $11\angle 30^\circ$

10. The switch S is closed at t = 0. The rate of change of current $\frac{di}{dt}(0+)$ is given by

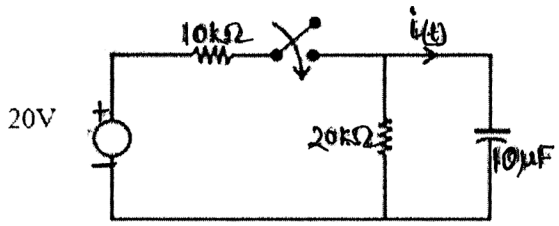


$R_s=100\Omega, I_s=0.1A$

L=2H

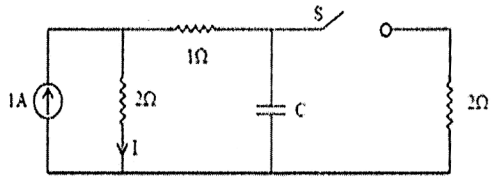
(a) 1A/sec (b) 5A/sec (c) 2.5A/sec (d) 3A/sec

11. For the circuit shown, the switch is closed at t = 0 (after having been open for a very long time. The current i(t) is given by (for t>0)



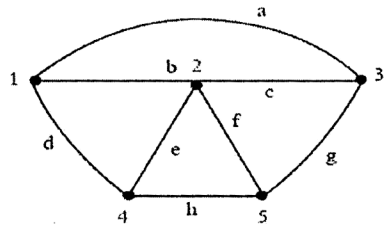
(a) $i(t) = 10(1 - e^{-5t})$ (b) $i(t) = 12 - e^{-5t}$ (c) $i(t) = 10 - e^{-10t}$ (d) $i(t) = 2e^{-15t}$

12. The steady state in the circuit shown in the given figure is reached with S open. S is closed at t=0. The current I at $t=0^+$ is



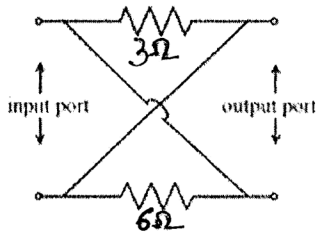
(a) 3A (b) 4A (c) 2A (d)1A

13. Identify which of the following is not a tree of the graph shown in figure



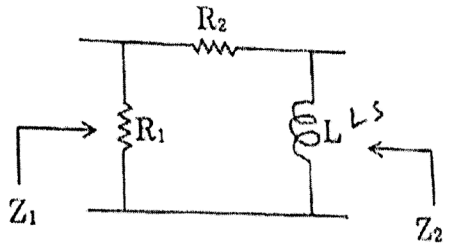
(a) adhg (b) aegh (c) begh (d) defg

14. The Z parameter matrix for the two port network shown in the figure is



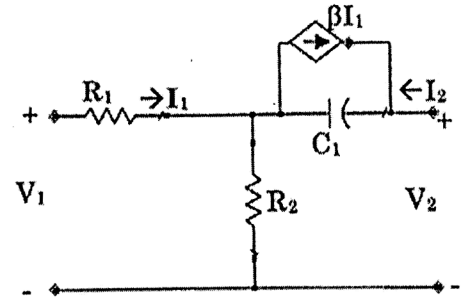
(a) $\begin{bmatrix} 2 & -2 \\ -2 & 2 \end{bmatrix}$ (b) $\begin{bmatrix} 2 & 2 \\ 2 & 2 \end{bmatrix}$ (c) $\begin{bmatrix} 9 & 3 \\ 6 & 9 \end{bmatrix}$ (d) $\begin{bmatrix} 9 & -3 \\ 6 & 9 \end{bmatrix}$

15. For the circuit shown below $Z_1=\frac{K_1(S+2)}{S+5}$ Find Z_2.Where K_1 and K_2 are constants containing circuit elements values



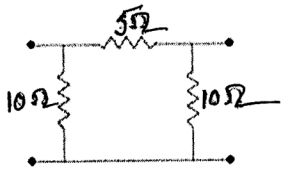
(a) $K_2\frac{S}{S+5}$ (b) $\frac{S+5}{SK_2}$ (c) $K_2\frac{S}{S+6}$ (d) $\frac{S+6}{SK_2}$

16. For a network shown in figure which of the following statement is true



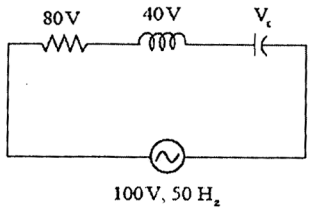
(a) Neither symmetric nor reciprocal (b) Symmetric but non-reciprocal
(b) (c) Reciprocal but not symmetric (d) Reciprocal and symmetric

17. The two port admittance matrix of the circuit shown in the figure is



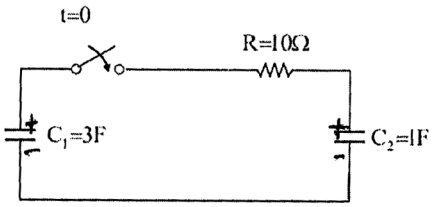
(a) $\begin{bmatrix} 15 & 5 \\ 5 & 15 \end{bmatrix}$ (b) $\begin{bmatrix} 3.33 & 5 \\ 5 & 3.33 \end{bmatrix}$ (c) $\begin{bmatrix} 0.3 & 0.4 \\ 0.4 & 0.3 \end{bmatrix}$ (d) $\begin{bmatrix} 0.3 & -0.2 \\ -0.2 & 0.3 \end{bmatrix}$

18. The voltage across the capacitor of the network shown in the figure



(a) 200 (b) 50 (c) 100 (d) 150

19. In the circuit shown, the initial voltages across the capacitors C_1 and C_2 are 1 V and 3 V, respectively. The switch is closed at time t = 0. The total energy dissipated (in Joules) in the resistor R until steady state is reached is



(a) 2.5 (b) 2 (c) 1.5 (d) 3.5

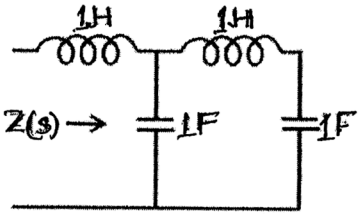
20. An LC tank circuit consists of an ideal capacitor C connected in parallel with a coil of inductance L having an internal resistance R . The resonant frequency of the tank circuit is

(a) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1-R^2\frac{C}{L}}$ (b) $\frac{1}{2\pi\sqrt{LC}}$ (c) $\frac{1}{2\pi\sqrt{LC}}(1-R^2\frac{C}{L})$ (d)) $\frac{1}{2\pi\sqrt{LC}}\sqrt{1-\frac{L}{CR^2}}$

21. The first and the last critical frequencies (singularities) of a driving pint impedance function of a passive network having kinds of elements, are a pole and a zero respectively. The above property will be satisfied by

(a) LC network only (b) RL network only (c) RC as well as RL networks (d) RC network only

22 . The driving point impedance Z(s) for the circuit shown below is

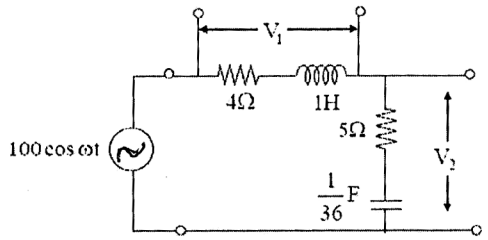


(a) $\frac{S^4+2S^2+4}{S^2+2}$ (b)) $\frac{S^3+1}{S^4+S^2+1}$ (c) $\frac{S^4+3S^2+1}{S^3+2S}$ (d)) $\frac{S^2+1}{S^4+S^2+1}$

23. The first and the last critical frequency of an RC-driving point impedance function must respectively be

(a) A pole and a pole (b) A pole and a zero (c) A zero and a pole (d) A zero and a zero

24. The figure shows an RLC circuit excited by sinusoidal voltage 100cos3t, where t is in second. The ratio $\frac{Amplitude\ of\ V_2}{Amplitude\ of\ V_1}$ is

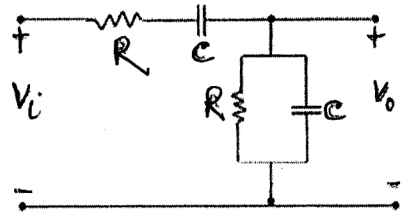


(a) $\frac{7}{12}$ (b) $\frac{12}{7}$ (c) $\frac{13}{5}$ (d) $\frac{5}{13}$

25. A series RLC circuit has a resonance frequency of 1 kHz and a quality factor Q=100. If each R, L and C is doubled from its original value, the new Q of the circuit is

(a) 50 (b) 25 (c) 200 (d) 100

26. The RC circuit shown in the figure



a) a low-pass filter b) a high-pass filter c) a band-pass filter d) a band-reject filter

27. The damping ratio of a series RLC circuit can be expressed as

(a) $\frac{R}{2}\sqrt{\frac{C}{L}}$ (b)) $\frac{2}{R}\sqrt{\frac{L}{C}}$ (c) $\frac{CR^2}{2L}$ (d) $\frac{2L}{CR^2}$

28. In non-linear network does not satisfy

(a) Superposition condition (c) Both homogeneity and superposition condition

(b)Homogeneity condition (d) Homogeneity, superposition and associative condition

29. The number of independent equations to solve a network is equal to

(a)The number of chords (c) Sum of the number of branches and chords
(b) The number of brunches (d) Sum of the number of branches, chords and nodes

30. A network has 4 nodes and 3 independent loops. What is the number of branches in the network
(a) 6 (b) 8 (c) 7 (d) 5

31. The theorem that enables a number of voltage (or current) sources to be combined directly into a single voltage (or current) source is

(a) Milliman's theorem (b) Maxwell's theorem (c) Compensation theorem (d) Reciprocity theorem

32. How do the series resonant circuit behave under the resonance condition?
(a) Current amplifier (b) Transconductance amplifier (c) Voltage regulator (d) Voltage amplifier

33. Consider the assertions given below. Which among them do/does not specify/ies the property of 'Complete Incidence Matrix'?

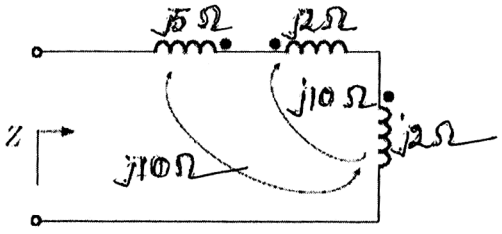
(a)Determinant of a loop of a complete incidence matrix is always zero
(b) Addition of all entries in any column should never be equal to zero
(c)Rank of connected or oriented graph is always 'n-1'
(d) All of the above

35. Which of the following is a positive real function
(a) $\frac{(S+1)(S+2)}{(S^2+1)^2}$ (b) $\frac{S^4+S^2+1}{(S+1)(S+2)(S+3)}$ (c) $\frac{(S-1)(S+2)}{S^2+1}$ (d) $\frac{S-1}{S^2-1}$

36. Both odd and even parts of a Hurwitz polynomial P(s) have roots
(a) in the right-half of s-plane. (b) in the left-half of s-plane.
(c) on the σ -axis only. (d) on the $j\omega$ -axis only

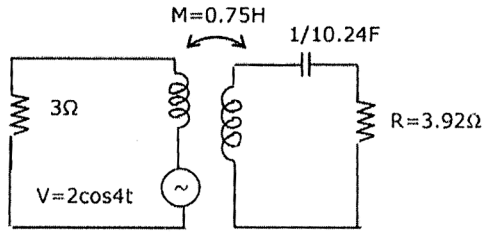
37. Which of the following is not a Hurwitz polynomial
(a) $(s+1)(s^2+2s+3)$ (b) $(s+3)(s^2+s-2)$
(c) $(s^3+3s)(1+\frac{2}{s})$ (d) $(s+1)(s+2)(s+3)$

38. Impedance Z as shown in the figure is



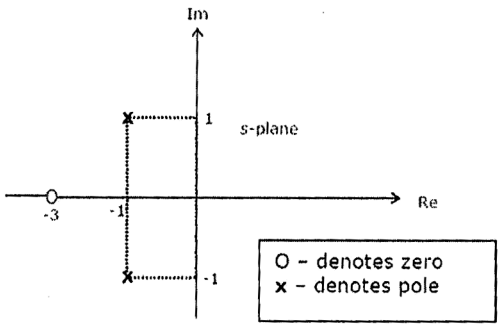
(a) j29Ω (b) j9Ω (c) j19Ω (c) j39Ω

39. The current flowing through the resistance R in the circuit in figure has the form P cos 4t, where P is



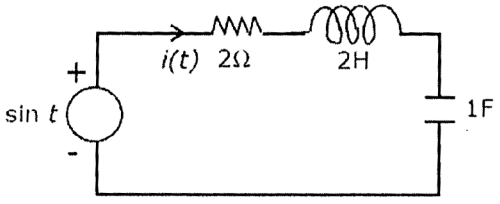
(a) (0.18+j0.72) (b) (0.46+j1.90) (c) -(0.18+j1.90) (d) (0.192+j0.144)

40. The driving point impedance Z(s) of a network has the pole-zero locations as shown in figure. If Z(0) =3, then Z(s)



(a) $\frac{2(S+3)}{S^2+2S+2}$ (b) $\frac{3(S-3)}{S^2-2S-2}$ (c) $\frac{2(S-3)}{S^2-2S-2}$ (d) $\frac{3(S+3)}{S^2+2S+3}$

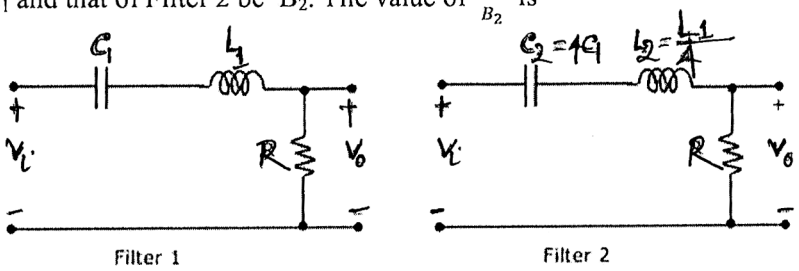
41. The differential equation for the current i(t) in the circuit of figure given below is



(a) $2\frac{d^2i}{dt^2}+2\frac{di}{dt}+i(t)=\sin t$ (b) $\frac{d^2i}{dt^2}+2\frac{di}{dt}+2i(t)=\cos t$

(c) $2\frac{d^2i}{dt^2} + 2\frac{di}{dt} + i(t) = \cos t$ (d) $\frac{d^2i}{dt^2} + 2\frac{di}{dt} + 2i(t) = \sin t$

42. Two series resonant filters are as shown in the figure. Let the 3-dB bandwidth of Filter 1 be B_1 and that of Filter 2 be B_2. The value of $\frac{B_1}{B_2}$ is



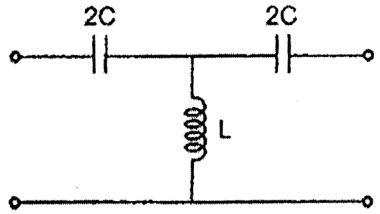
Filter 1 Filter 2

(a) 4 (b) 1 (c) 0.5 (d) 0.25

43. Where do the correctly terminated asymmetrical networks show termination at both the ports of network?
(a) In image impedances (b) In iterative impedances
(c) In characteristic impedances (d)All of the above

44. The current leads supply voltage if a series resonant circuit exhibits its operation
(a) Above the resonant frequency (b) Below the resonant frequency
(c) Equal to the resonant frequency (d) None of the above

45. For the design of prototype high pass filter T section, what would be the value of inductor if design impedance and cut-off frequency are 600 ohm and 1500 Hz respectively (given C=88.41 nF



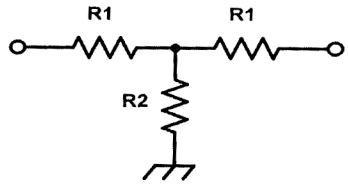
(a) 19.89 mH (b) 31.83 mH (c) 40.13 mH (d) 51.83 mH

46.Suppose that a network consists of purely resistive elements, what will be the value of propagation constant (generated output) in terms of attenuation constant and phase constant from the following?
(a) $\gamma = \alpha + j0$ (b) $\gamma = 0 + j\beta$
(c) $\gamma = 0 - j\beta$ (d) $\gamma = \alpha - j0$

47. Which value of 'm' is selected in a composite filter, while connecting the terminating sections in order to acquire proper impedance matching and constant characteristic impedance throughout the pass band

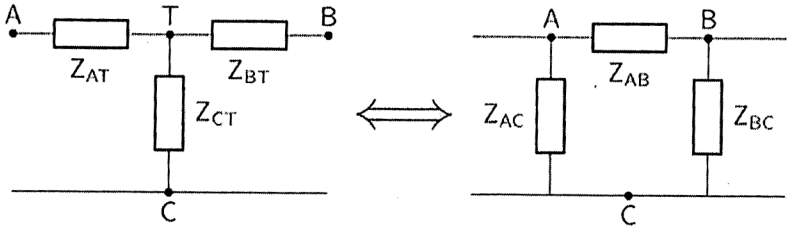
(a) 0.3 (b) 0.6 (c) 0.9 (d) 0.12

48. What would be the characteristic impedance of a T-section for symmetrical network shown below (R_1=200Ω, R_2=600 Ω)



(a) 300.15 ohm (b) 529.15 ohm (c) 715.15 ohm (d) 900.15 ohm

49. If the given two networks are equivalent then Z_{AB} , Z_{BC} , Z_{CA} respectively (Z_{AT}=6Ω Z_{BT}=6Ω Z_{CT}=9Ω)

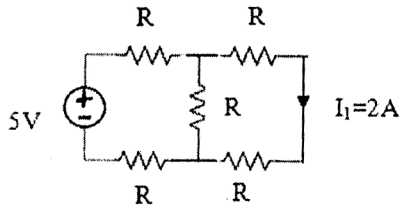


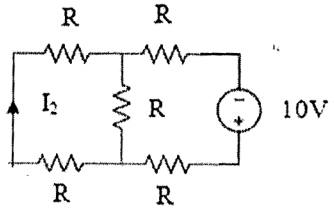
(a) 16Ω ,24Ω, 16Ω (b) 16Ω ,16Ω, 24Ω (c) 16Ω ,24Ω, 24Ω (d) 24Ω, 16Ω, 16Ω

50. If the impedance of each phase of a balanced star connected load is 3+2j what will be the impedance equivalent delta connected load

(a) 3+6j (b) 3+2j (c) 2+3j (d) 9+6j

51.





The value of I_2 is (a) -2A (b) 4A (c)2A (d) -4A

52. The y parameters of a network are

$$[y]=\begin{bmatrix}0.5 & -0.2\\ -0.2 & 0.4\end{bmatrix}$$

The corresponding Z parameter is

(a) $\begin{bmatrix}2.5 & 1.25\\ 1.25 & 3.125\end{bmatrix}$ (b) $\begin{bmatrix}2.5 & -1.25\\ -1.25 & 3.125\end{bmatrix}$ (c) $\begin{bmatrix}0.4 & 0.2\\ 0.2 & 0.5\end{bmatrix}$ (d) $\begin{bmatrix}2 & -5\\ -5 & 2.5\end{bmatrix}$

53. In a certain parallel resonant band pass filter, the resonant frequency is 14 kHz. If the bandwidth is 4 kHz the lower frequency is
(a) 7 kHz (b) 10 kHz (c) 12 kHz (d) 11 kHz

54. An RC high-pass filter consist of an 820Ω resistor. What is the value of C so that X_c is ten times less than R at input frequency of 12 kHz
(a) 0.161 μF (b) 161 μF (c) 2.2 μF (d) 8.1 μF

55. Which filter has a maximally flat response

(a)Bessel (b)Butterworth (c) Chebyshev (d) all of the above

56. A certain current source has the values $I_S = 4$ μA and $R_S = 1.2$ MΩ. The values for an equivalent voltage source are

(a) 4.8 μV, 1.2 MΩ (b) 1 V, 1.2 MΩ (c) 4.8 V, 4.8 MΩ (d) 4.8 V, 1.2 MΩ

57. Step response of series RC circuit with applied voltage V is of the form

(a) $i(t) = -\frac{V}{R}e^{\frac{-t}{RC}}$ (b) $i(t) = \frac{V}{R}e^{\frac{-t}{RC}}$ (c) $i(t) = -\frac{V}{R}(1 - e^{\frac{-t}{RC}})$ (d) $i(t) = \frac{V}{R}(1 - e^{\frac{-t}{RC}})$

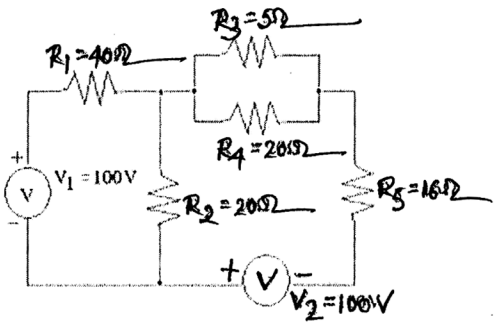
58. For a two port reciprocal network, the three transmission parameters are given by A = 4, B = 7 and C = 5. The value of D is equal to

(a) 8.5 (b) 9 (c) 9.5 (d) 8

59. The short circuit and open circuit impedance of a network are respectively $Z_{oc} = 120\Omega$ and $Z_{sc} = 30\Omega$, the characteristic impedance of the network is

(a) 30 Ω (b) 60Ω (c) 120 Ω (d) 150 Ω

60. Voltage across 16Ω resistor is



(a) 80V (b) 128V (c) 32V (d) 64V