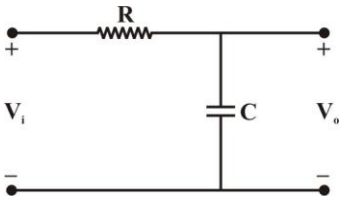
Network Objective Solution (ESE-2015 Test Series Dated 03.04.2015)

1. (A)



$$\frac{V_o}{V_i} = \frac{1}{1+SCR}$$

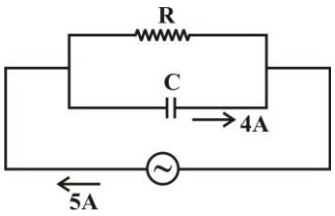
$$\frac{|V_o|}{|V_i|} = \frac{1}{\sqrt{1+\omega^2R^2C^2}}$$

At $f = 0$; $V_o(o/p)$ will have maximum voltage.

2. (C) For domestic load such as AC induction meter, power factor is very small. And to increase value of power factor, a capacitor is connected in parallel with load. By using this, power factor can be made unity.

3. (A) If determinant becomes zero $i_c[A] = 0$ than no. of trees = 0

4. (C)



$$I_R = \sqrt{5^2 - 4^2} = 3A$$

$$I_R = 3A$$

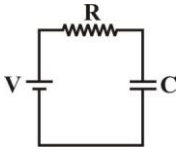
$$R = \frac{V}{I_R} = \frac{240}{3}80\Omega$$

5. (A) $z_y = n^2 z_x \quad \Rightarrow \quad z_y = 4 \times z_x = 4\Omega$

$$\frac{V_2}{V_1} = \frac{n_2}{n_1} = 2$$

$$V_2 = 2V_1 = 2\sin\omega t.$$

6. (D)



$$V_c(t) = V\left(1 - e^{-t/RC}\right)$$

$$E_1 = CV^2$$

$$E_2 = \frac{1}{2}CV^2$$

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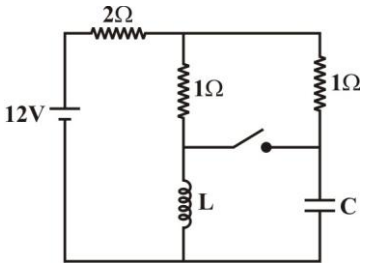
$$\frac{E_1}{E_2} = 2$$

7. (A) $j12 = j2 + j8 + 2M$

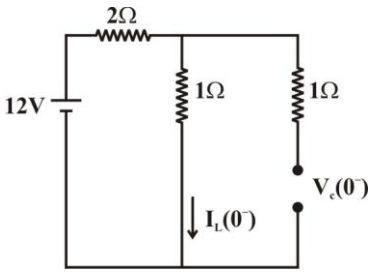
$2M = j2 \quad M = j1 = k\sqrt{j2 \times j8} \qquad k = 0.25$

8. (B) Links – Current – Fundamental loop
Branch – Voltage – Cut-set matrix

9. (A)



At $t = 0^-$;

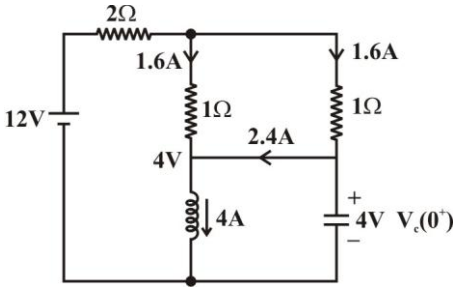


$$I_L\left(0^-\right) = \frac{12}{2+1}$$

$= 4A$

$V_c = 4V$

At $t = 0^+$;



$$\frac{12 - V_x}{2} = \frac{V_x - 4}{1} + \frac{V_x - 4}{1}$$

$V_x = 5.6V \qquad I\left(\text{capacitor}\right) = 0.8A$

10. (B)

11. (C)

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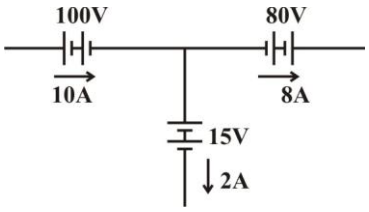


Power Absorbed: $P = 1000 - 640 + 30 \qquad P = 390$

12. (C)
13. (A)
14. (D) In dual circuit design all values remain same Except resistance values change to conductance value.
15. (D)
16. (B)
17. (B)
18. (A)
19. (D) Magnitude Scaling :

$$z_R = R \qquad z_L = j\omega L \qquad z_C = \frac{1}{j\omega C}$$

$$z_R' = k_m R \quad z_L' = k_m \cdot j\omega L \quad z_C' = \frac{k_m}{j\omega C}$$

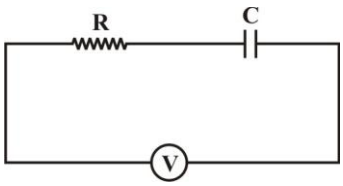
$$R' = k_m R \quad L' = k_m L \qquad C' = \frac{C}{k_m}$$

$$\omega_0 = \frac{1}{\sqrt{L'C'}} = \frac{1}{LC} = \omega_0$$

Frequency Scaling

Frequencies are changed but impedances will remain same.

20. (A)



$$I = \frac{V}{R + \frac{1}{j\omega C}}$$

$$|I| = \frac{V}{\sqrt{R^2 + \frac{1}{(\omega C)^2}}}$$

$$R >> \frac{1}{\omega C} \qquad \therefore \qquad |I| = V \;\rightarrow\; \text{Angle} \rightarrow 0^o$$

21. (A)
22. (C) $P_{apparent} = \sqrt{P^2 + Q^2} = \sqrt{2^2 + 3.5^2} = 4.03$

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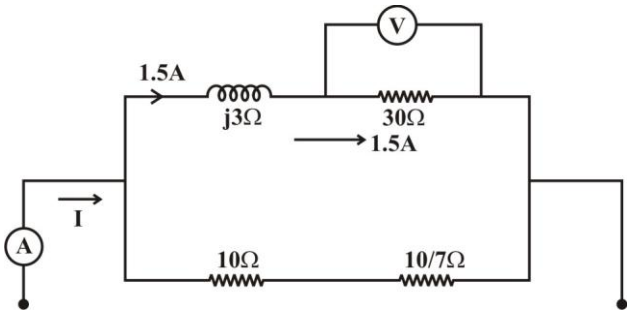
23. (B)

24. (B) Square wave = V_m Sine wave $= \frac{V_m}{\sqrt{2}}$

Triangular $= \frac{V_m}{\sqrt{3}}$ Half wave rectified $= \frac{V_m}{2}$

25. (C)



$$R = 10 + \frac{10}{7} = \frac{80}{7}\Omega$$

$$I_2 = \left(\frac{30 + j3}{30 + j3 + \frac{80}{7}} \right) I$$

26. (B) it is 50% efficiency

27. (B)

28. (A) Source resistance should be minimum for maximum power transfer.

29. (A)

30. (A) Invalid LC impedance. $\therefore$ Foster realization is not possible.

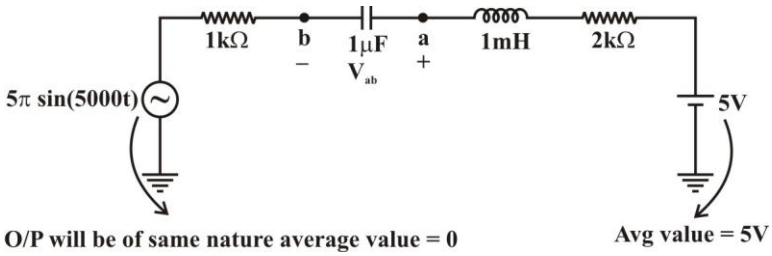
31. (B) $f_1 \rightarrow$ value of frequency at which capacitor voltage has maximum value.

$$f_c = \frac{1}{2\pi}\sqrt{\frac{1}{LC} - \frac{R^2}{2L^2}}$$

$$f_L = \frac{1}{2\pi\sqrt{LC}} \times \frac{1}{\sqrt{1 - \frac{R^2 C}{2L}}}$$

$$f_L > f_c$$

32. (B)



33. (B)

34. (D) Coefficients must be positive real.

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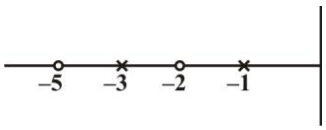
35. (B)



In RC driving point impedance, first frequency shall be pole.

Poles and zeroes should be interlaced.

36. (A) $[B]=\begin{bmatrix}1&0&0&1&0&0\\0&1&0&0&0&-1\\0&0&1&1&-1&-1\end{bmatrix}$ (–ve transpose)

$[Q]=\begin{bmatrix}-1&0&-1&1&0&0\\0&0&1&0&1&0\\0&1&1&0&0&1\end{bmatrix}$ Twig matrix will always be square matrix.

37. (D) $z=R-\dfrac{j}{\omega C}$

$z=R-jR$ (for maximum power)

$z=R\sqrt{2}\angle -45^{o}$

$\cos\phi=\dfrac{R}{z\angle\theta} \Rightarrow \text{P.F.}=\cos 45^{o}=\dfrac{1}{\sqrt{2}}\text{ lead }=0.707\text{ lead}$

38. (C)

39. (D) $V=\dfrac{1}{C}\int_0^t i(t)dt \qquad V_c(t)=\dfrac{1}{C}.i.t=kt$

40. (C)

41. (A) Poles and zeros are not interlaced.

42. (C) $I_{rms}=0.5=I_m \qquad P_{avg}=I_{rms}^2\cdot R=(0.5)^2\times 4=1W$

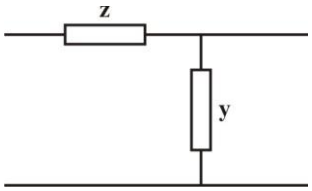
43. (B) $300=\dfrac{(30)^2}{R} \qquad R=3\Omega$

$P_{avg}=I_{rms}^2\cdot R \Rightarrow 108=I_{rms}^2\cdot 3 \qquad I_{rms}=6A$

$I_{rms}=\dfrac{V_{rms}}{R+jX} \Rightarrow 6=\dfrac{30}{\sqrt{R^2+X^2}}$

$R^2+X^2=5^2 \quad X=4\Omega=\text{Reactance}$

44. (C)



$A=1+zy \qquad B=z \qquad C=y \qquad D=1$

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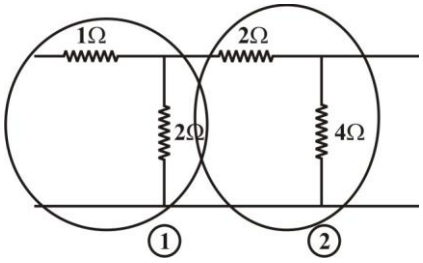


(1) $[T]=\begin{bmatrix}1.5 & 1\\ 0.5 & 1\end{bmatrix}$

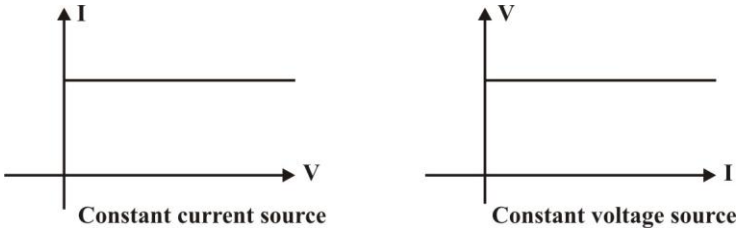
(2) $[T]=\begin{bmatrix}1.5 & 2\\ 0.25 & 1\end{bmatrix}$

Beth are cascaded.

$[T]=[T_1][T_2]$

$D=0.5\times2+1\times1=2$

45. (B)



46. (B) $y=\frac{1}{R}+j\omega C+\frac{1}{j\omega L}=\frac{1}{R}+j\left(\omega C-\frac{1}{\omega L}\right)$

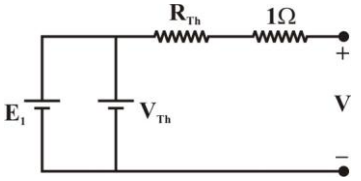
$I=v.y \Rightarrow \frac{V}{R}+jV\left(\omega C-\frac{1}{\omega L}\right)$

If $\omega L>1/\omega C$ Current will lag.

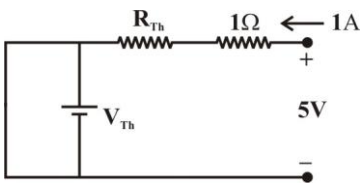
47. (A)

48. (C)

49. (B)



$I=0,\ V=5V=V_{Th}$



$I=1A,\ 5=R_{Th}+1,\ R_{Th}=4\Omega$

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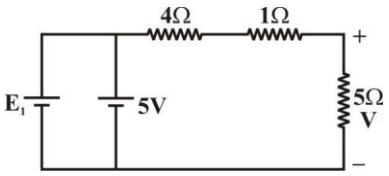


$$V_x = \frac{5\times 5}{10} = 2.5V$$

50. (A) $z(s) = \dfrac{\left(s+\sqrt{3}\right)\sqrt{3}}{\sqrt{3}s+1}$

$$\omega = 1; \quad z(s) = \frac{\sqrt{3}+j}{1/\sqrt{3}+j} = \frac{V}{I}$$

$$\frac{V}{I} = \frac{\angle 30^\circ}{\angle 60^\circ} \qquad \therefore \quad \text{I leads voltage by } 30^\circ.$$

51. (A) $V_c = 3V$ (steady state at $t = 0^-$)

$Q = C\times V = 3C.$

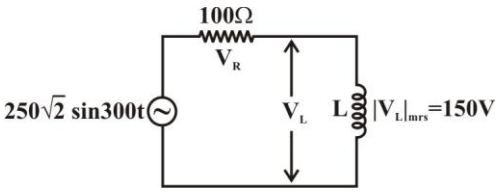
Let V is the common potential. $C_1V + C_2V = 3$

$\boxed{V = 1V}$

52. (D)

53. (C) Energy given by battery = $CV^2 = 0.9\mu J$ $E = 10^{-7}\times 9 = 0.9\mu J$

54. (B)



$V_s = 250\sqrt{2}\sin 300t$

$$(V_s)_{rms} = \frac{250\sqrt{2}}{\sqrt{2}} = 250$$

$V_{rms}^2 = V_R{}^2 + V_L{}^2 \qquad (250)^2 = V_R{}^2 + (150)^2$

$V_R = 200V$

$$I_{rms} = \frac{V_{rms}}{R} = \frac{200}{100} = 2A$$

$|V_L|_{RMS} = \omega L I_{rms}$

$150 = 300\times L\times 2 \qquad L = 0.25H$

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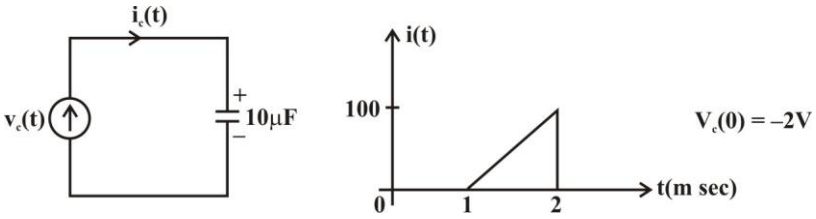
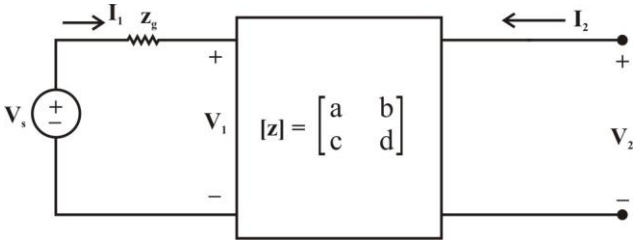
55. (B)



$$V_c(t) = -2 + \frac{1}{C}\int_1^2 100(t-1)\,dt = -2 + \frac{1}{10^{-5}} \times 100\left(\frac{t^2}{2} - t\right)_1^2 = 3V.$$

56.



$$V_s = V_1 + z_g I_1 \qquad \text{— (1)}$$

$$V_1 = aI_4 + bI_2 \qquad \text{— (2)}$$

$$V_2 = cI_1 + dI_2 \qquad \text{— (3)}$$

$$V_s = (a + z_g)I_1 + bI_2 \qquad \text{— (4)}$$

$$I_1 = \frac{V_s - bI_2}{a + z_g}$$

$$V_2 = C\left(\frac{V_s - bI_2}{a + z_g}\right) + dI_2 \qquad \frac{V_2}{I_2} = d - \frac{bc}{(a + z_g)}$$

For objective Ans. should contain z_g $\therefore$ (a) or (c)

Put $z_g = 0$; $V_s = aI_1 + bI_2$ and $V_s = 0$

$$I_1 = -\frac{b}{a}I_2 \qquad \frac{V_2}{I_2} = d - \frac{bc}{a}$$

57. (C)

58. (D)

59. (C) $$y = \frac{1}{R + j10} + \frac{1}{4 - j5}$$

$$y = \frac{R - j10}{R^2 + 100} + \frac{4 + j5}{25 + 16}$$

For resonance $$\frac{10}{R^2 + 100} = \frac{5}{41}$$

$$R^2 + 100 = 82$$

60. (B)

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