Electrical Engineering - Optional For IAS (UPSC)

Circuit Theory - 2015-2021

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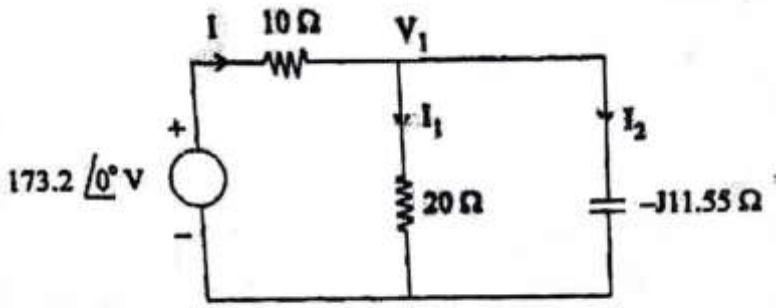
UPSC – ELECTRICAL Engineering optional – 2015 Questions

1.For the circuit shown in Figure, evaluate the current through and the voltage across each element. **[10M]**

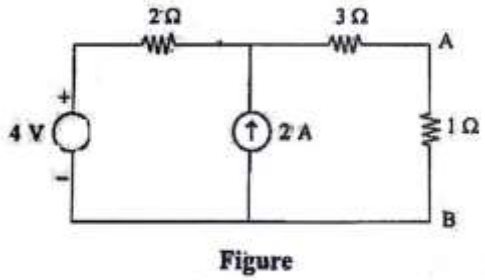


Figure

2. Derive the expressions for instantaneous and average power in a single-phase ac circuit. **[10M]**

3. A two-port network has $z_{11} = z_{12} = z_{21} = z_{22} = 200\Omega$. Two such networks are connected in cascade. What are the overall z-parameters of the composite network. **[10M]**

4.In the network shown in Figure, determine the value of current through 1 Ω resistance connected between terminals A and B. Verify the answer using superposition theorem also. **[20M]**



Figure

UPSC – ELECTRICAL Engineering optional – 2016 Questions

1. The reduced incidence matrix of an oriented graph is given as **[10M]**

$$\begin{bmatrix} 0 & -1 & 1 & 0 & 0 \\ 0 & 0 & -1 & -1 & -1 \\ -1 & 0 & 0 & 0 & 1 \end{bmatrix}$$

(i) Draw the graph.

(ii) How many trees are possible for this graph?

(iii) Write the tie-set matrix.

2. Two impedances $z_1 = 5\Omega$ and $z_2 = (5 - jX_c)\Omega$ are connected in parallel and this combination is connected in series with $z_3 = (6.25 + j1.25)\Omega$. Determine the value of capacitance of X_C to achieve resonance if the supply is 100 V, 50 Hz. **[10M]**

3. For the circuit shown in Fig.2 (a), find the value of V, if the power dissipation in the load resistance R_L is 36 watts: **[20M]**

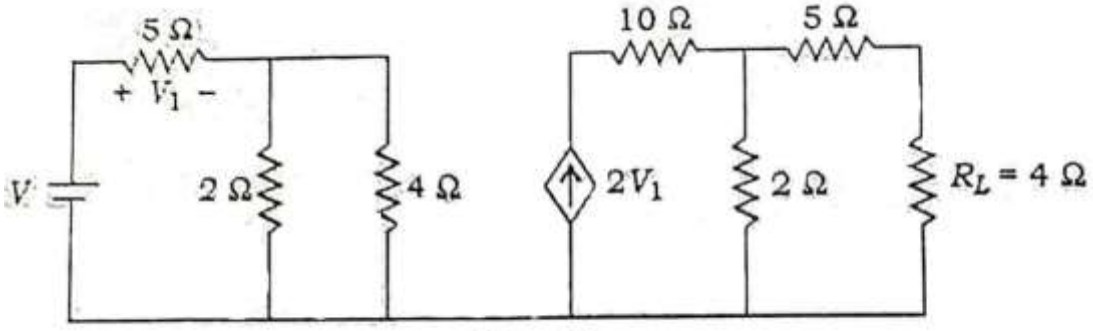


Figure 2(a)

4. Obtain the dotted equivalent circuit for the coupled circuit shown in Fig 3(a) and hence find the voltage across the capacitor: **[20M]**

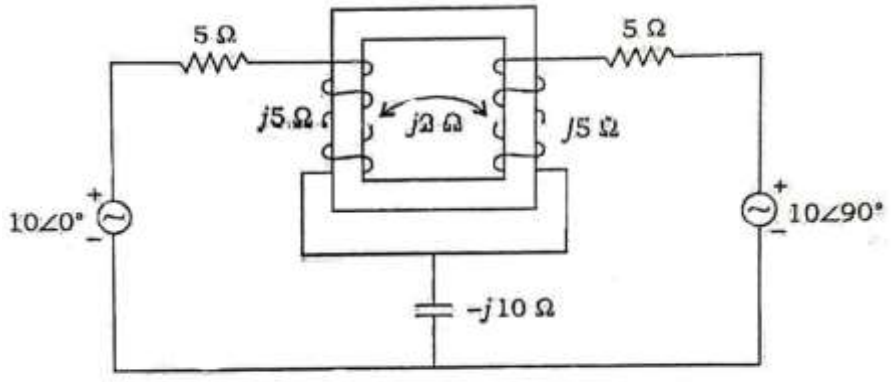
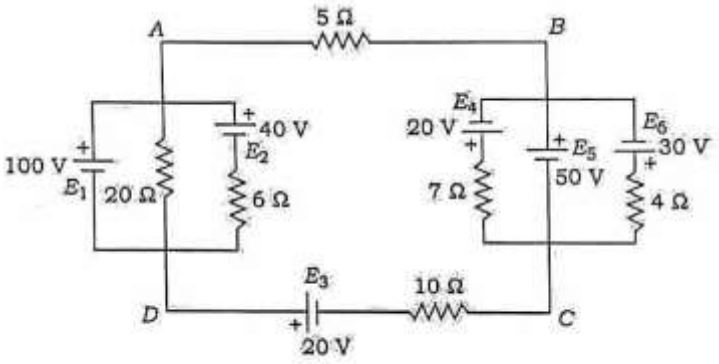


Figure 3(a)

UPSC – ELECTRICAL Engineering optional – 2017 Questions

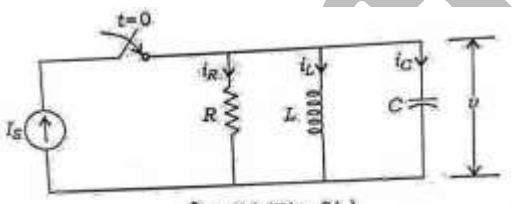
1. For the circuit shown in Fig 1(a), find the current through 5Ω resistor by using Thevenin's theorem and verify the same by using superposition theorem. **[10M]**



चित्र 1(a)/Fig. 1(a)

2. Consider the R-L-C circuit shown in Fig. 3(c), wherein $I_S = 10A, R = 2\Omega, L = 1\ H,\ C = 0.5\ \mu F, i_L(0^-) = 0$

Determine $v(0^+)$, $\frac{dv}{dt}(0^+)$ and $\frac{d^2v}{dt^2}(0^+)$ after the switch is closed. **[10M]**



चित्र 3(c)/Fig. 3(c)

3. Obtain z-parameters of a two-port network in terms of its ABCD parameters. **[10M]**

4. Find the value of average current flow through the load resistor for the circuit given in figure 6 (a) **[10M]**

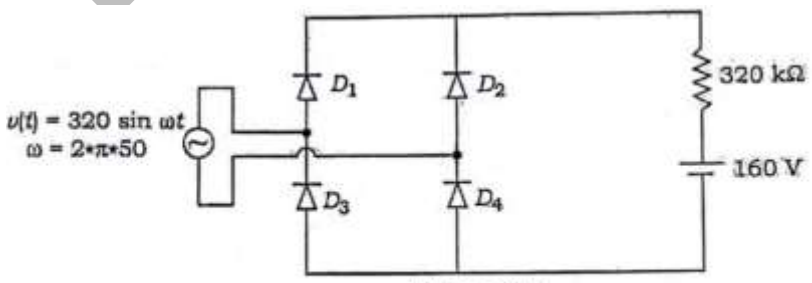


Fig. 6(a)

5. A 400-V, 3-phase balanced source is connected to an unbalanced Δ-connected load of impedances $\bar{Z}_{ab} = 10\angle + 45°\Omega$, $\bar{Z}_{bc} = 10\angle 0°\Omega$ and $\bar{Z}_{ca} = 10\angle - 45°\Omega$. Determine the line currents (in phasor form), total active (real) and reactive powers. **[20M]**

UPSC – ELECTRICAL Engineering optional – 2018 Questions

1. Derive the expression of total average power in three-phase balanced circuit. **[10M]**

2.In the circuit shown in Figure 3(c), find the voltage v_o across the 8 Ω resistor. **[10M]**

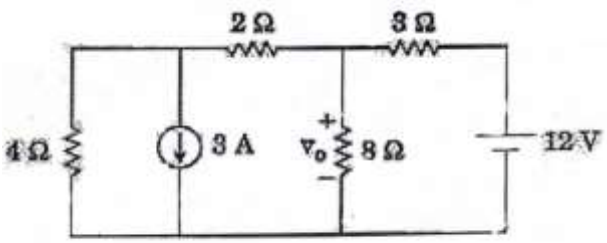


Figure 3(c)

3. Using Thevenin's theorem, find the current through the 40 Ω resistor connected between terminals a and b in Figure 5(e). **[10M]**

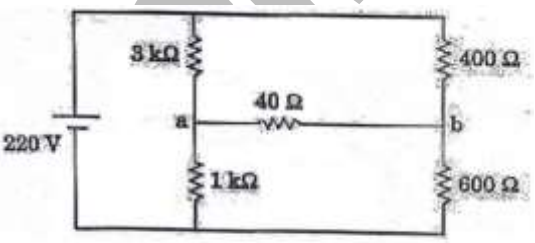


Figure 5 (e)

4. Find $i_o(t)$ in the circuit shown in Figure 6(b) using Fourier transform method when $i_s(t) = 10 \sin 2t$ Amp. **[20M]**

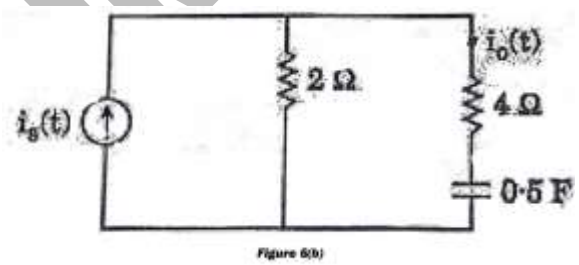


Figure 6(b)

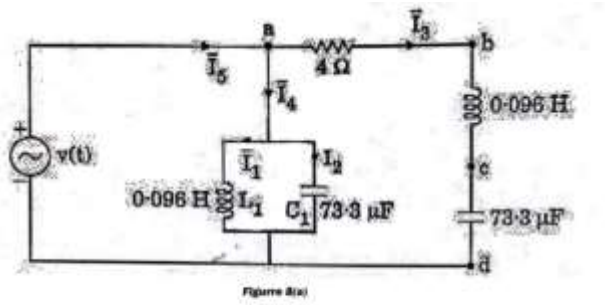
5. For the circuit shown in Figure 8(a), $v(t) = 311.12 \sin 377t$ volts: **[20M]**

(i) Find the values of $\bar{I}_1, \bar{I}_2, \bar{I}_3, \bar{I}_4$ and $\bar{I}_5$.

(ii) Also compute $\bar{V}_{bc}$ *and* $\bar{V}_{cd}$.

(iii) Compute the power supplied by the source.

(iv) Find the line power factor.



UPSC – ELECTRICAL Engineering optional – 2019 Questions

1. In the network shown in Figure 1(a), determine the following:

(i) The value of the load resistance to have maximum power transfer

(ii) The maximum power delivered to the load. **[10M]**

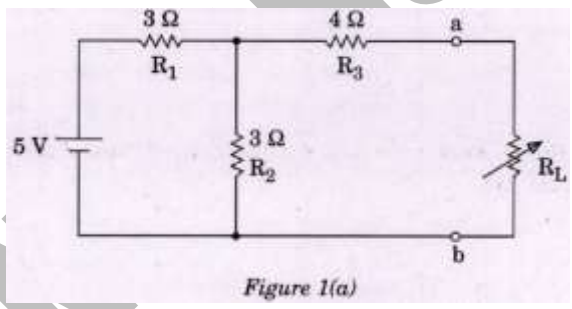


Figure 1(a)

2. Determine the expressions of currents i_1 and i_2 in time domain for the circuit shown in Figure 2 (a). **[20M]**

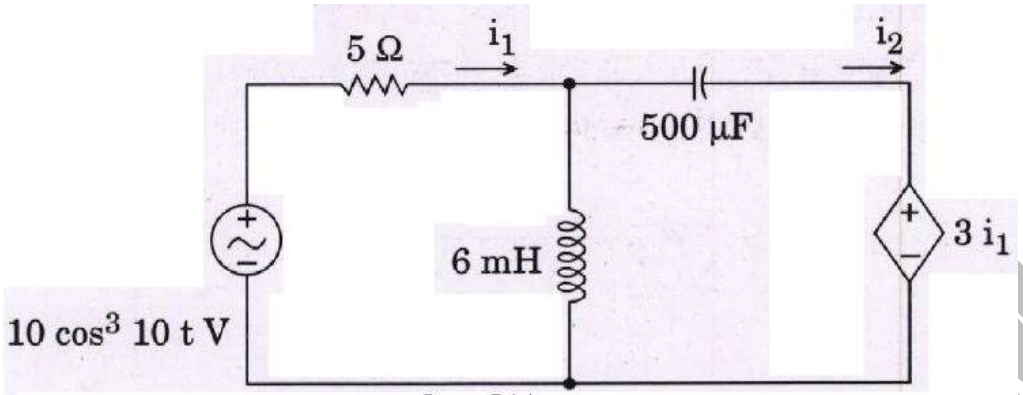


Figure 2 (a)

3. Determine current i(t) in the circuit of Figure 3(d), for all values of time. **[10M]**

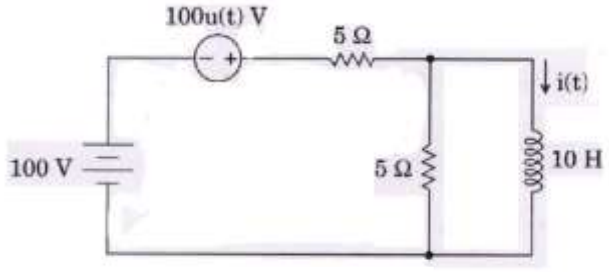


Figure 3 (d)

4. A balanced three-phase supply system with a line voltage of 400 V is supplying a balanced Y-connected load with 1500 W at a leading power factor of 0.8. Determine the line current and the per phase load impedance. Now, a balanced 900 W lighting load is added in parallel to the system. What will be the new line current? **[10M]**

UPSC – ELECTRICAL Engineering optional – 2020 Questions

1. The switch shown in Figure 1(a) has been closed for a very long time and it is opened at time $t = 0$. **[10M]**

(i) Find the value of i_L for $t < 0$.

(ii) Just after the switch is opened, find the value of $i_L(0^+)$.

(iii) Determine the expression for $i_L(t)$ for $t > 0$ and find the value of $i_L(\infty)$.

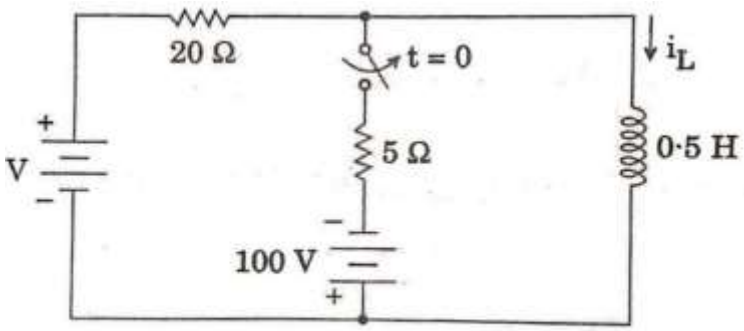


Figure 1(a)

2. Find the h-parameters of the two-port circuit shown in Figure 2a. If the input contains a source voltage with series resistance of 200Ω, find the output impedance (Z_{out}) of the circuit. **[10M]**

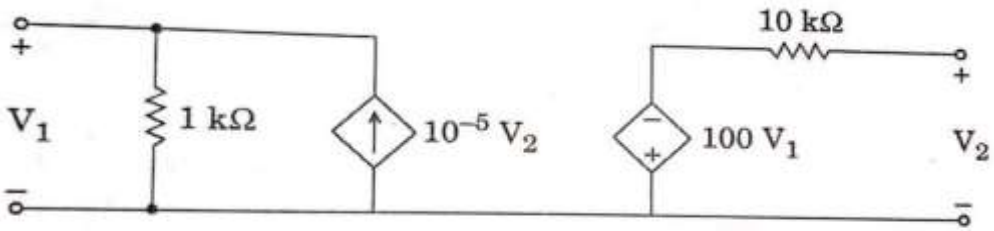


Figure 2(a)

3. Let $\omega = 1000$ rad/sec for the circuit of Figure 3b and determine the value of the ratio V_0/V_s, $L_1 = 1$ mH, $L_2 = 25$ mH and $k = 1$. **[10M]**

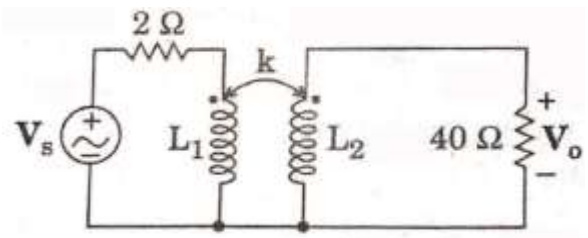


Figure 3(b)

4. An electrical network is fed by two ac sources, as shown in Figure 3b(ii). Given that $Z_1 = (1 - j)\Omega$, $Z_2 = (1 + j)\Omega$ and $Z_L = (1 + j0)\Omega$. **[10M]**

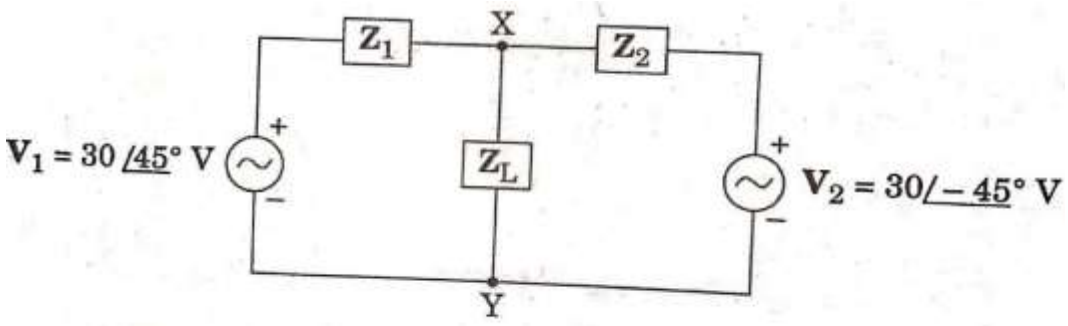


Figure 3(b)(ii)

5. Find the values of branch currents I_a, I_b, and I_c as indicated in the circuit of Figure 5(e). **[10M]**

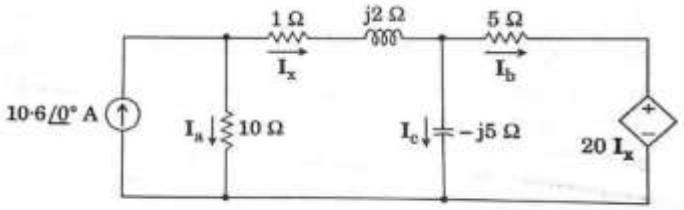


Figure 5(e)

UPSC – ELECTRICAL Engineering optional – 2021 Questions

1. In Figure 1(a) shown below, the two-port network is characterized in terms of y-parameters with $y_{11} = 3.3 \times 10^{-3}$S, $y_{22} = 5 \times 10^{-3}$S and $y_{12} = y_{21} = 0$. Find the voltage across 200Ω load. **[10M]**

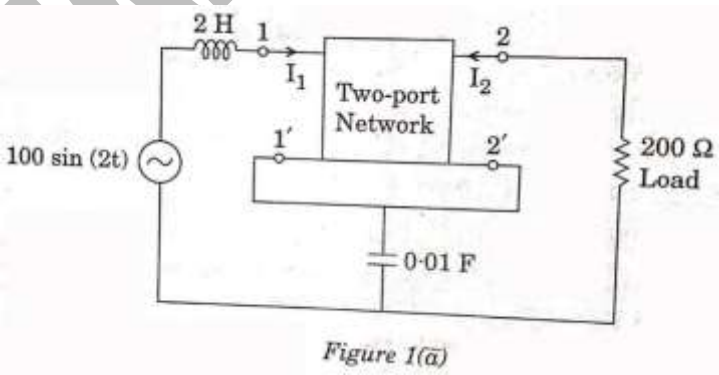


Figure 1(a)

2. Find the Thevenin's equivalent of the circuit shown in Figure 2(a) below as seen from the load impedance Z_L. Also find the value of Z_L for maximum power transfer. **[20M]**

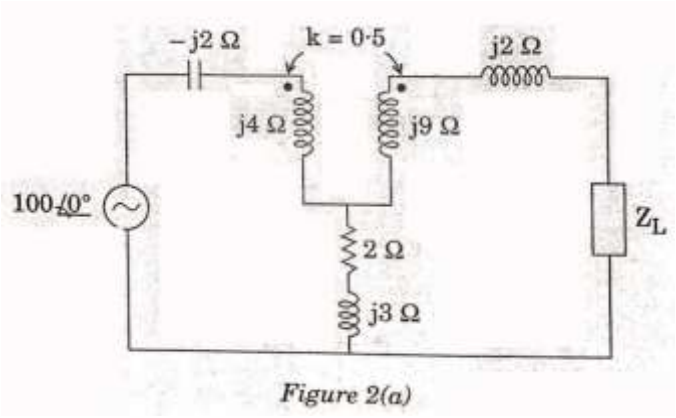


Figure 2(a)

3. For the circuit shown in Figure 3(b), calculate the voltage $V_0(t)$ as function of time,**[20M]**

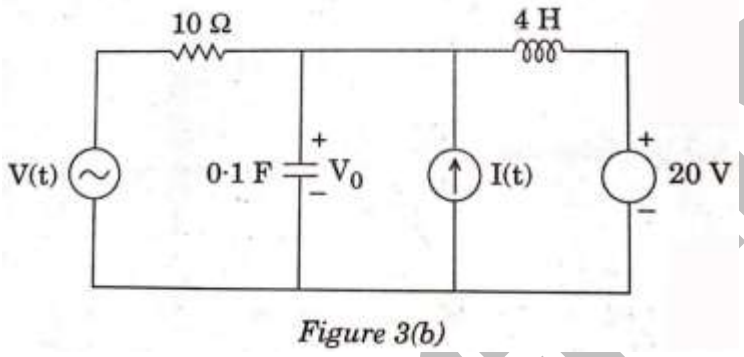


Figure 3(b)

Where $V(t) = 10\sin(6t + 60°)V$ and $I(t) = 5\cos(4t + 30°)A$.

4. For the circuit shown in Figure 5(e), $v_C(0+) = 2$ V and $i(0+) = \frac{2}{3}$A. Calculate the value of $v_C(t)$for $t > 0$. **[10M]**

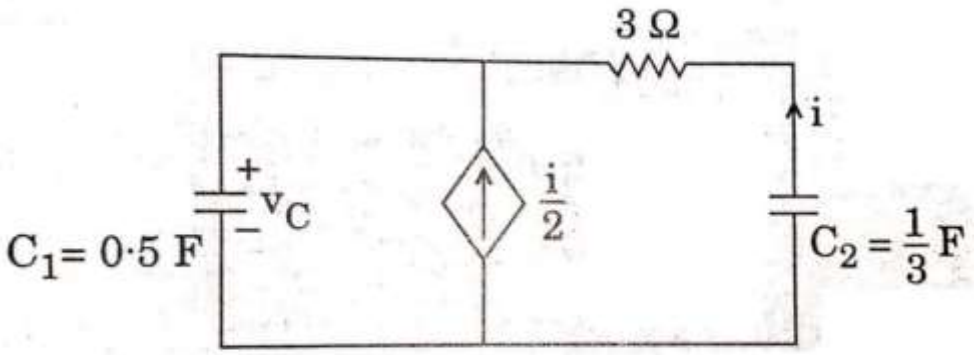


Figure 5(e)