

$$\therefore Z_{23} = \frac{1}{Y_{23}} = \frac{1}{13.502 \times 10^{-3}} \quad | \underline{1.123^\circ}$$

$$= 74.063 \quad | \underline{-1.123^\circ} \quad \text{JR}$$

$$= 74.649 - j 1.463$$

$$\therefore Z_t = Z_1 + Z_{23} = 200 - j 79.620 + 74.649 - j 1.463$$

$$= 274.649 - j 81.083$$

$$= 286.368 \quad | \underline{\phi_t = -16.448^\circ} \quad \text{JR}$$

$$\therefore I_t = \frac{V}{Z_t} = \frac{400 \quad | \quad 0^\circ}{286.368 \quad | \underline{\phi_t = -16.448}}$$

$$= 1.397 \quad A \quad | \underline{\phi_t = 16.448}$$

$$\text{P.F.} = \cos 16.448 = 0.959 \quad \text{(2)}$$

$$P = V I \cos \phi = 400 \times 1.397 \cos 16.448$$

$$= 535.932 \text{ watt} \quad \text{(2)}$$

$$Q = V I \sin \phi = 400 \times 1.397 \sin 16.448$$

$$= 158.221 \text{ VAR} \quad \text{(2)}$$

$$S^1 = V I = 400 \times 1.397 = 558.8 \text{ VA}$$

$$P = Z_2 \quad 1.397 \quad | \underline{16.448 \times 113.214} \quad | \quad -$$

2) For the circuit shown in Fig. 4, Find:-

- 1 The total impedance Z
- 2- The current in R_2
- 3- The supply current
- 4- The voltage across R_2
- 5- The power factor
- 6- The P, Q, S
- 7 - Draw The phasor diagram, the impedance- and power diagram.

Solution :-

$$\omega = 2\pi f = 2\pi \times 50 = 314 \text{ rad/sec}$$

$$X_{C_1} = \frac{1}{\omega C} = \frac{1}{314 \times 40 \times 10^{-6}} \\ = 79.62 \Omega$$

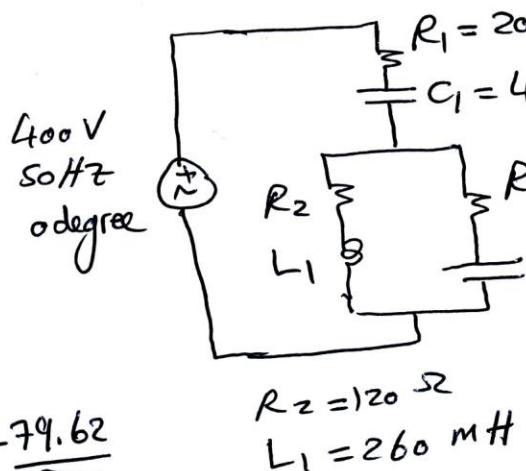
$$\begin{aligned} Z_1 &= R_1 - j X_{C_1} = 200 - j 79.62 \\ &= \sqrt{(200)^2 + (-79.62)^2} \quad \left[\tan^{-1} \frac{-79.62}{200} \right] \\ &= 215.266 \quad \left[-21.708^\circ \right] \Omega \end{aligned}$$

$$\begin{aligned} Z_2 &= R_2 + j \omega L_1 = 120 + j 314 \times 260 \times 10^{-3} \\ &= 120 + j 81.64 = 145.138 \quad \left[34.229^\circ \right] \end{aligned}$$

$$Y_2 = \frac{1}{Z_2} = \frac{1}{145.138 \quad \left[34.229^\circ \right]} = 6.89 \quad \left[-34.229^\circ \right]$$

$$\begin{aligned} Z_3 &= R_3 - j X_{C_2} = 100 - j \frac{1}{314 \times 60 \times 10^{-6}} \\ &= 100 - j 53.679 = 113.214 \quad \left[-27.959^\circ \right] \end{aligned}$$

$$Y_3 = \frac{1}{Z_3} = \frac{1}{113.214 \quad \left[-27.959^\circ \right]} = 8.833 \quad \left[27.959^\circ \right]$$



$$R_2 = 120 \Omega \\ L_1 = 260 \text{ mH}$$

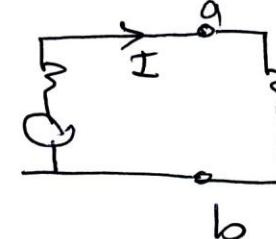
1.c) Continue :

$$5 - \text{Half the maximum power} = \frac{P_{L\max}}{2} = \frac{1.037}{2} =$$

$$\therefore I = \frac{E_{th}}{R_{th} + R_{L_2}}$$

$$\therefore \text{The power} = I^2 R_L$$

$$R_{th} =$$



$$= \frac{E_{th}^2}{(R_{th} + R_{L_2})^2} \cdot R_{L_2} = \frac{P_{\max}}{2} = 0.519$$

$$= \frac{16}{(3.857 + R_{L_2})^2} R_{L_2}$$

$$\therefore 0.519 (3.857 + R_{L_2})^2 = 16 R_{L_2}$$

$$(3.857)^2 + 2 \times 3.857 R_{L_2} + R_{L_2}^2 = 30.829 R_{L_2}$$

$$14.876 + 7.714 R_{L_2} - 30.829 R_{L_2} + R_{L_2}^2 =$$

$$\therefore R_{L_2}^2 - 23.115 R_{L_2} + 14.876 = 0$$

$$R_{L_2} = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \frac{(23.115 \pm \sqrt{(23.115)^2 - 4 \times 1 \times 14.876})}{2}$$

$$= \frac{23.115 \pm 21.79}{2} = 0.663 \Omega$$

$$\text{or } \frac{22.453}{\Omega}$$

$\therefore P_{L_2} = 0.519 \text{ watt}$ for both cases

$$P_1 \neq P_{L\max} = 1.037 \text{ watt}$$

1.c) For the circuit shown in Fig. 3, find :

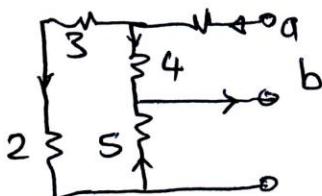
- 1- The value of R_L to be connected between a and b to obtain the maximum power dissipated in it.
- 2- The value of this maximum power
- 3- The value of R_L to obtain $\frac{1}{2} P_{max}$.

Solution :

i) Find E_{Th} , R_{Th} :

$R_{Th} = 2\Omega$ is s.c & 2A in o.c.

$$R_{Th} = \frac{(3+2+5) \times 4}{3+2+5+4} + 1 \\ = \frac{40}{14} + 1 = 3.857 \Omega$$



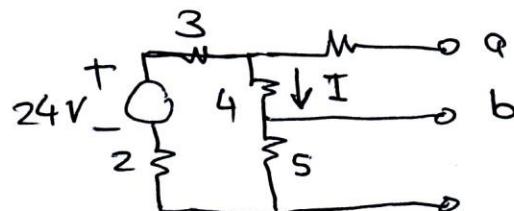
3

2) E_{Th} :-

24 is applied only :-

$$I = \frac{24}{3+2+4+5} = \frac{24}{14} = 1.714 \text{ A}$$

$$\therefore E_{ab} = E_{Th_1} = I \times 4 = 4 \times 1.714 = 6.856 \text{ Volt}$$

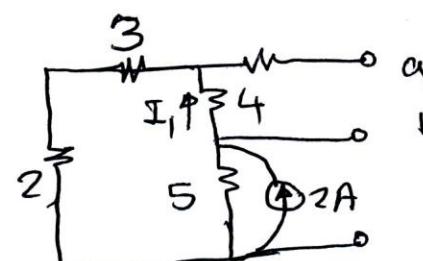


E_{Th_1}

2A is applied only :-

4 & 3Ω are in series = 9Ω

$$\therefore I_1 = 2 \times \frac{5}{5+9} = \frac{10}{14} = 0.714 \text{ A} \uparrow$$



$$\therefore E_{Th_2} = E_{ab} = -I_1 \times 4 = -0.714 \times 4 = -2.857$$

$$\therefore E_{Th} = E_{ab} = 6.856 - 2.857 = 3.999 = 4$$

3

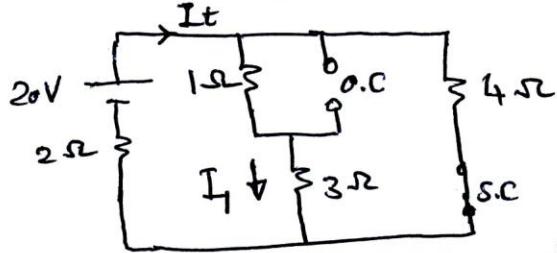
3- The value of R_L to be connected between a and b to obtain $\frac{1}{2} P_{max}$.

3.857 Ω

1.b) In Fig. 2, Use the Superposition Theorem to find the current I. 10 Marks

Solution:

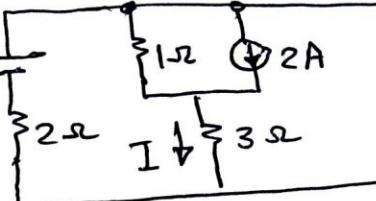
1) The voltage source 20V is applied, 2A is open circuited, 16V is short circuited.



$$R_t = \frac{(3+1)4}{4+4} + 2 = 4 \Omega \quad \text{Fig. 2}$$

$$\therefore I_t = \frac{20}{R_t} = \frac{20}{4} = 5 \text{ A}$$

$$\therefore I_1 = I_t \times \frac{4}{4+(3+1)} = 2.5 \text{ A} \downarrow$$

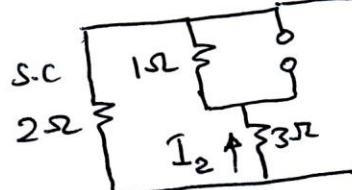


2) The 16V is applied, 2A is O.C & 20V is S.C :-

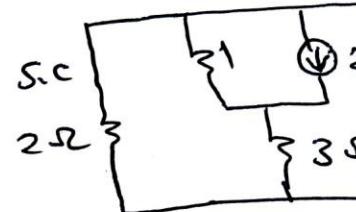
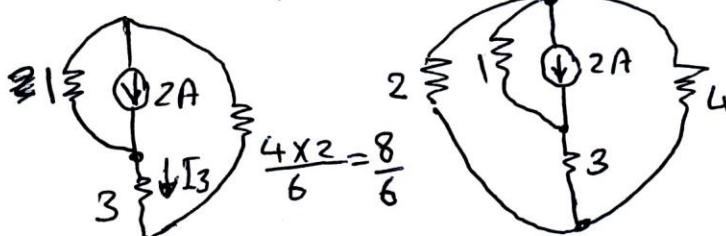
$$R_t = \frac{(3+1)2}{3+1+2} + 4 = 1.333 + 4 \\ = 5.333 \Omega$$

$$\therefore I_t = \frac{16}{R_t} = \frac{16}{5.333} = 3 \text{ A}$$

$$\therefore I_2 = I_t \times \frac{2}{2+(3+1)} = 3 \times \frac{2}{6} = 1 \text{ A} \uparrow \quad \text{---} \quad (3)$$



3) 2A is applied, 16V and 20V are short circuited



$$I_3 = 2 \times \frac{1}{1 + (3 + \frac{4 \times 2}{6})} = \frac{2}{5.333} = 0.37 \quad (3)$$

Then The total current I in 3Ω = $I_1 + I_2 + I_3$

$$1 + 0.375 = 1.375 \text{ Amp} \downarrow$$

Final Term Exam.

29 / 12 / 2014

Model Answer : of The Exam.

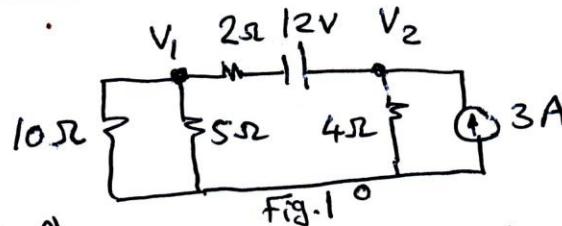
The first Page :

1.a) For the circuit shown in Fig.1 , Find V_1 and V_2 .

Solution:

Use Node method:

- The total no. of nodes = 3
- Take one as a reference point 0
- Transpose the Voltage Source 12, 2Ω to the equivalent Current Source $I = \frac{12}{2} = 6 A$ → and $R = 2 \Omega$
- Write the two node equations V_1 and V_2



$$\begin{array}{l} V_1 \\ (\frac{1}{10} + \frac{1}{5} + \frac{1}{2}) \\ - \frac{1}{2} \end{array} \quad \begin{array}{l} V_2 \\ - \frac{1}{2} \\ (\frac{1}{4} + \frac{1}{2}) \end{array} \quad \begin{array}{l} = \frac{I}{6} \\ = 3 + 6 \end{array}$$

$$\therefore \begin{array}{l} V_1 \\ 0.8 \\ - 0.5 \end{array} \quad \begin{array}{l} V_2 \\ - 0.5 \\ 0.75 \end{array} \quad \begin{array}{l} = \frac{I}{6} \\ = - 6 \\ = 9 \end{array} \quad (4)$$

$$\therefore V_1 = \frac{\Delta_1}{\Delta}, \quad V_2 = \frac{\Delta_2}{\Delta}$$
$$\therefore V_1 = \frac{\begin{vmatrix} 0 & -0.5 \\ 0.8 & 0.75 \end{vmatrix}}{\begin{vmatrix} 0.8 & -0.5 \\ 0.75 & 0.75 \end{vmatrix}} = \frac{-6 \times 0.75 + 9 \times 0.5}{0.8 \times 0.75 - 0.5 \times 0.5} = \frac{0}{0.35} = 0$$



- Answer all the following question
- Illustrate your answers with sketches when necessary.
- The exam. Consists of two pages
- No. of questions : 4
- Total Mark: 100 Marks
- The first Page – 50 Marks

1.a) For the circuit shown in Fig. 1 , **Find** V₁ and V₂ . **(8 marks)**

1.b) In Fig. 2 , use the Superposition Thereom to find the current I. **(10 marks)**

1.c) For the circuit shown in Fig. 3, **Find:** 1- The value of RL to be connected between a and b to obtain the maximum power dissipated in it **(8 marks)**

2- The value of this maximum power **(2 marks)**

3- The value of RL to obtain half of the maximum power . **(2 marks)**

2) For the circuit shown in Fig. 4, **Find:** **(20 marks)**

- | | | |
|--------------------------------------|-----------------------|---|
| 1- The total impedance | 2- The supply current | 3- The current in R ₁ |
| 4- The voltage across R ₂ | 5- The power factor | 6- The total active power, reactive power and apparent power |
| | | 7- Draw the phasor, impedance and the power diagrams for the total equivalent circuit |

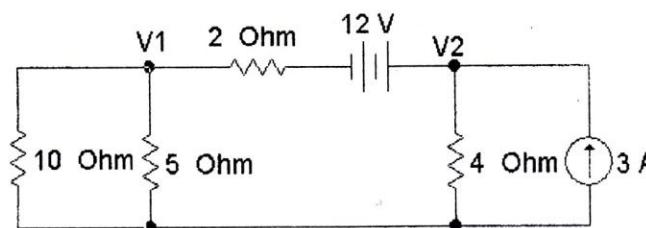


Fig. 1

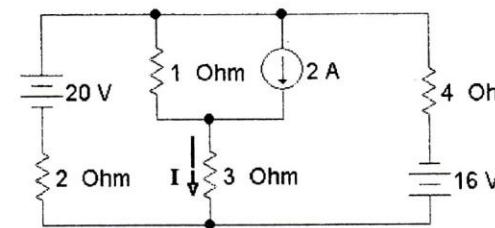


Fig. 2

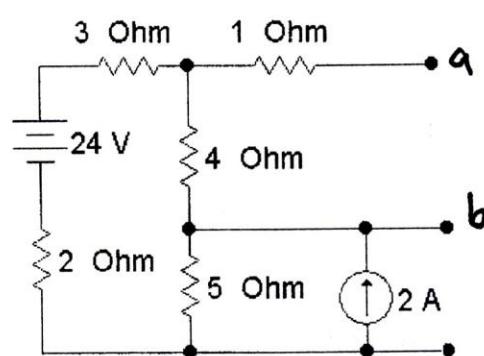


Fig. 3

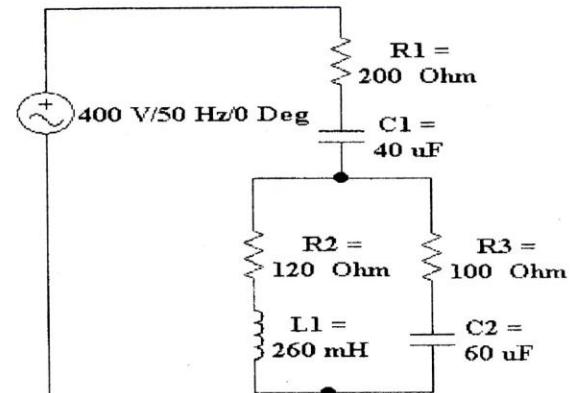
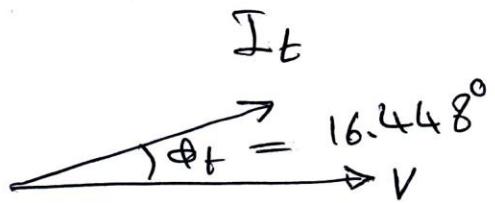
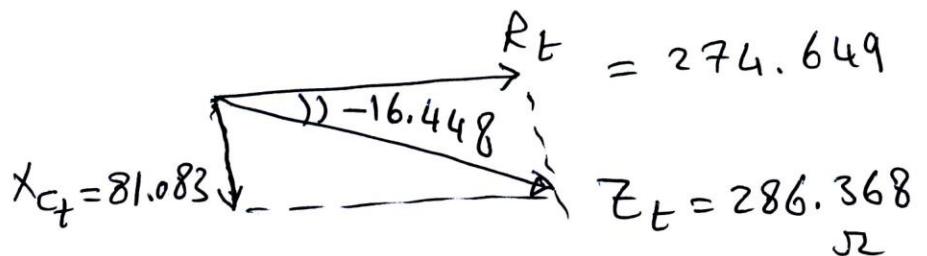


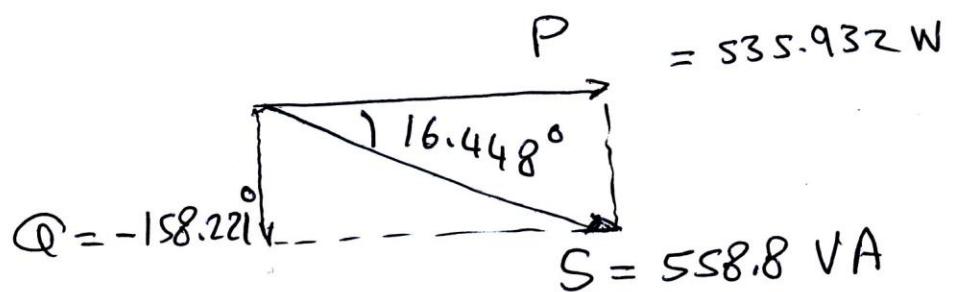
Fig. 4



phasor diagram ①



Impedance diagram ①



Power diagram ①