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Vellore Institute of Technology
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Vellore – 632014, Tamil Nadu, India

SCHOOL OF ELECTRICAL ENGINEERING

FALL SEMESTER 2023-2024

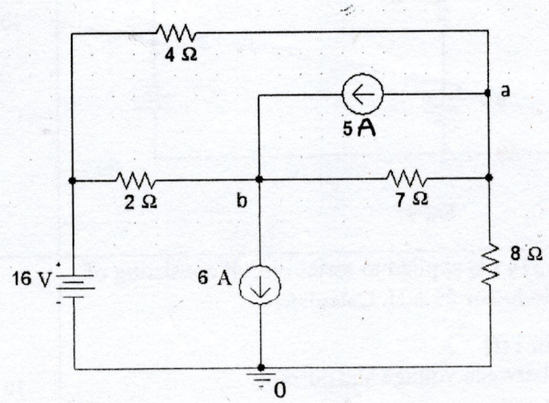
CAT-I

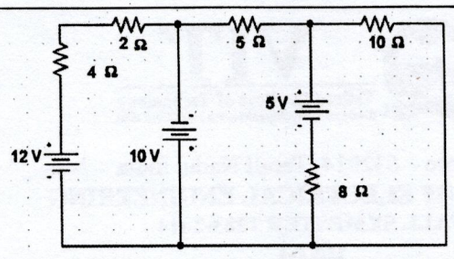
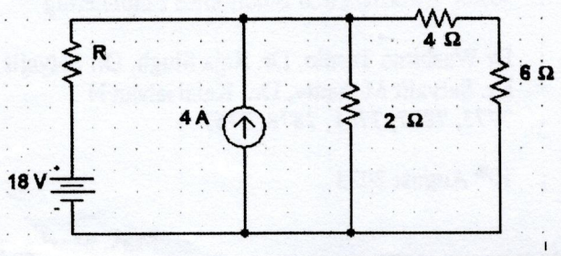
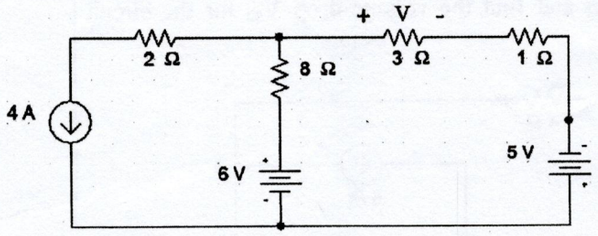
SLOT: A1+TA1

Programme Name & Branch	:	B.Tech. Course Code: BEEE102L
Course Name	:	Basic Electrical and Electronics Engineering
Faculty Members	:	Dr Washima Tasnin, Dr. Raja Singh, Dr. Satyajit Das, Dr. Satyajit Mohanty, Dr. Kalaiselvan N
Class Number(s)	:	7773, 7857, 7761, 7878, 7767
Date of the Examination	:	10th August 2023

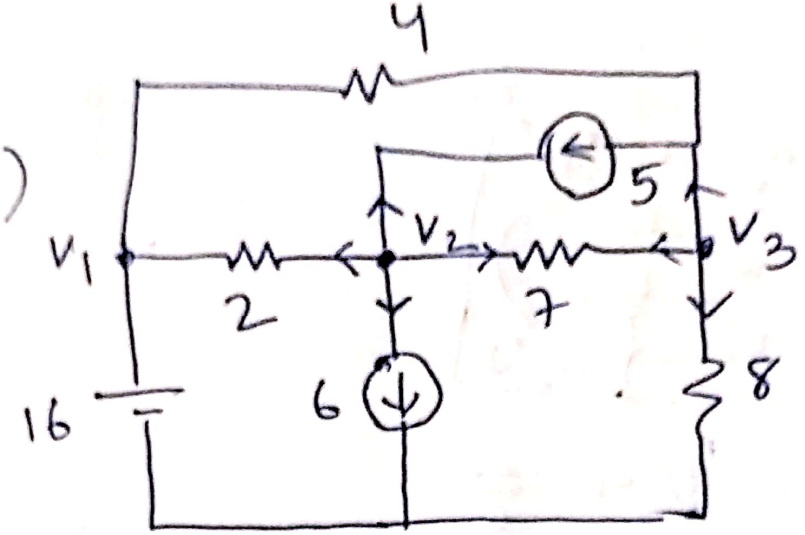
Duration : 90 minutes **Max. Marks : 50**

General instruction(s):

Q	Question	Marks
1	Apply Node analysis and find the voltage drop V_{ab} for the circuit shown in Fig. 1.  Fig. 1	10
2	Find the power delivered by the 10 V source by applying mesh analysis in the circuit shown in Fig. 2.	10

	 Fig. 2	
3	In the circuit shown in Fig. 3, find the value of R for which maximum power transfer takes place. Also, find the value of maximum power?  Fig. 3	10
4	Applying Superposition theorem, determine the current in 2 ohm resistor and voltage drop in 3 ohm resistor in the circuit shown in Fig. 4.  Fig. 4	10
5	A voltage V(t) = 50 sin 314 t is applied to series circuit consisting of 5 ohm resistance and a inductor 20 mH. Calculate 1. expression for i (t) 2. phase angle between voltage and current 3. power factor 4. active power consumed reactive power consumed by inductor	10

1)



$V_1 = 16$

$$\frac{V_2 - V_1}{2} + 6 + \frac{V_2 - V_3}{7} + (-5) = 0$$

$$7(V_2 - 16) + 84 + 2V_2 - 2V_3 - 70 = 0$$

$$\Rightarrow \quad 9V_2 - 2V_3 = 98$$

$$\frac{V_3}{8} + \frac{V_3 - V_2}{7} + 5 + \frac{V_3 - V_1}{4} = 0$$

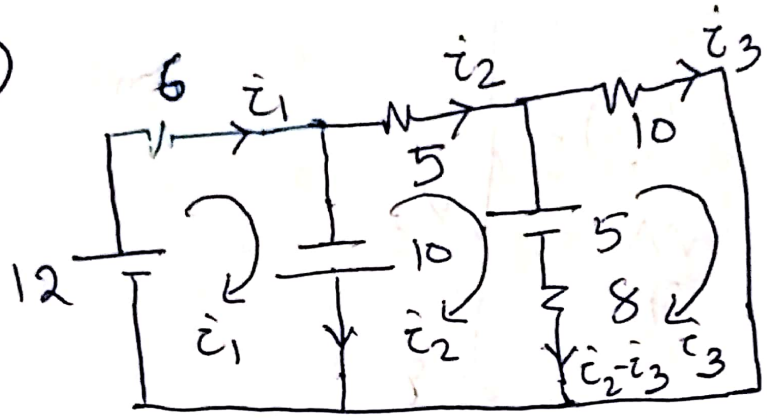
$$7V_3 + 8(V_3 - V_2) + 280 + 14(V_3 - V_1) = 0$$

$$29V_3 - 8V_2 - 14V_1 + 280 = 0$$

$$-8V_2 + 29V_3 = -56$$

$V_2 = 11.14\,V$, $V_3 = 11.142\,V$, $V_1 = 16\,V$

2)



$6i_1 - 10 - 12 = 0 \Rightarrow i_1 = \frac{22}{6}$

$5i_2 + 5 + 8(i_2 - i_3) + 10 = 0$

$13i_2 - 8i_3 = -15 \quad \text{---} (1)$

$10i_3 - 8(i_2 - i_3) - 5 = 0$

$-8i_2 + 18i_3 = 5 \quad \text{---} (2)$

Solving (1) and (2)

$i_2 = -1.35\ A$

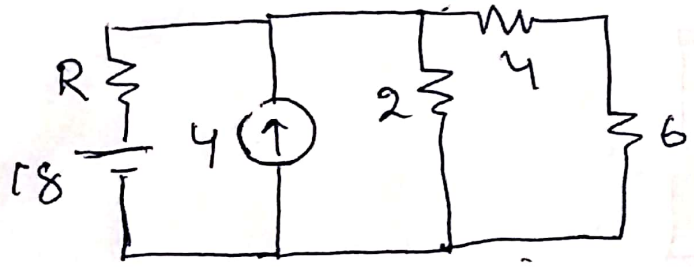
$i_3 = -0.323\ A$

P deliver ~~= 10 x~~ by 10V source $= 10 \times (i_1 - i_2)$

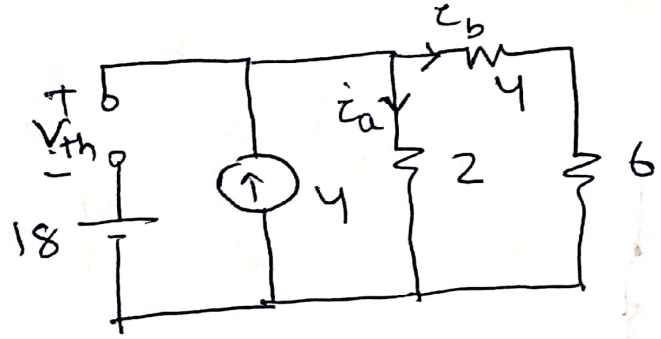
$= 10(3.66 + 1.35)$

$= 10 \times 5.02 = 50.2\ W$

3)



V_{th} =

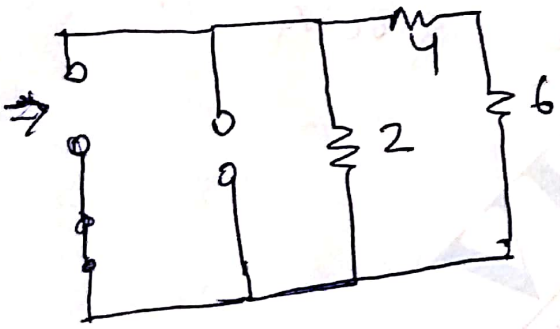


$i_a = 4 \times \frac{10}{12} = \frac{10}{3} = 3.33$; $V_{th} = 2i_a - 18$

$= 2 \times 3.33 - 18$

$= 11.34\ V$

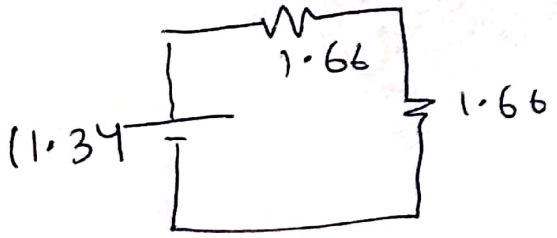
R_{th} =



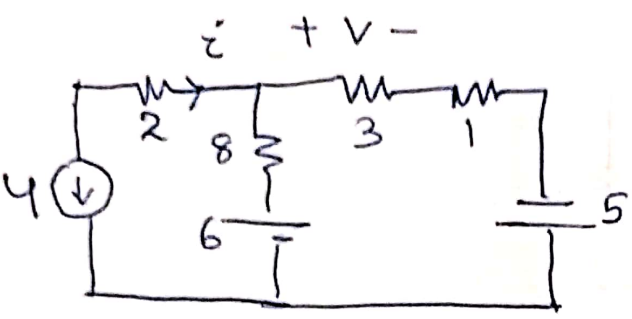
$R_{th} = \frac{10 \times 2}{10+2} = \frac{20}{12}$

$= 1.66\ \Omega$

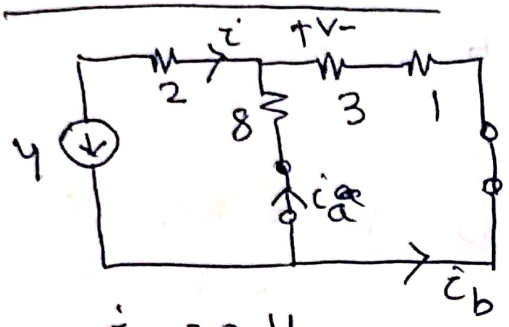
Thevenin equivalent circuit:



$P_{max} = i^2 R = \left(\frac{11.34}{2 \times 1.66}\right)^2 1.66 =$ 19.36 W.



4A source active

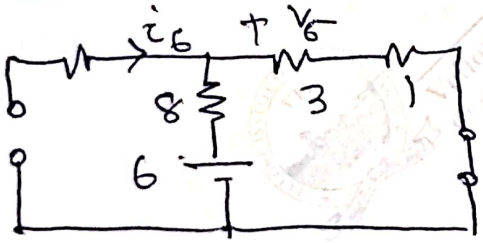


$i_4 = -4$

$i_b = 4 \times \frac{8}{4+8} = 4 \times \frac{8}{12} = 2.66\ A$

$V_4 = -3 i_b = 8V$

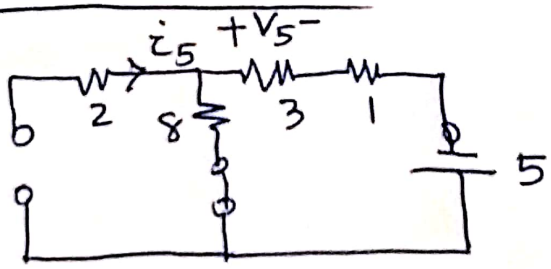
6V source active.



$i_6 = 0$

$V_6 = 3 \times \frac{6}{12} = 1.5\ V$

5V source active



$i_5 = 0$

$V_5 = 3 \times \frac{5}{12}$

$= 1.25\ V$

Total current $i = -4\ A$

$V = 2 + 1.5 + 1.25$

$= 4.75V$

5) $v(t) = 50 \sin 314t = \frac{50}{\sqrt{2}} \angle 0$

$R = 5, \quad L = 20mH$

$w = 314, \quad X_L = wL = 314 \times 20 \times 10^{-3} = 6.28\ \Omega$

$Z = R + jwL = 5 + j6.28 = 8.0 \angle 51.47\ \Omega$

$i(t) = \frac{50}{\sqrt{2}} \angle 0 \Big/ 8.0 \angle 51.47 = \frac{6.25}{\sqrt{2}} \angle -51.47 A$

a) $i(t) = 6.25 \sin(314t - 51.47)\ A$

b) phase angle between voltage and current $= 51.47$ lagging

c) power factor $= \cos 51.47 = 0.622$ lagging

d) $P = I_{rms}^2 R = \left(\frac{6.25}{\sqrt{2}}\right)^2 5 = (4.42)^2 \times 5 = 97.5W$

e) $Q = I_{rms}^2 X_L = \left(\frac{6.25}{\sqrt{2}}\right)^2 6.25 = 19.53 \times 6.25$

$= 121.875\ VAR$