Course's Name : Electric circuits I
Course's Number :12011101
Exam's Period :90 minutes
Questions' Number : 4
Total Mark :30
Pages' Number :4

Palestine Technical University - Kadoorie

First Exam

Spring 2017

Instructor's Name :.....
Student's Name: .....
Student's Number: .....
Section's Number: .....
Exam's Date :

Question 1 : (8 marks)

Using nodal analysis find power of 28 v voltage source

$\bar{V}_1 = -28$ ... (1)

$\bar{V}_3 = 4$ ... (1)

KCL at Node 2 ... (1)

$$\frac{\bar{V}_2}{8} + \frac{\bar{V}_2 - \bar{V}_1}{10} + \frac{\bar{V}_2 - \bar{V}_3}{4} = 0$$

$$\frac{\bar{V}_2}{8} + \frac{\bar{V}_2}{10} - \frac{\bar{V}_1}{10} + \frac{\bar{V}_2}{4} - \frac{\bar{V}_3}{4} = 0$$

$$\bar{V}_2\left[\frac{1}{8} + \frac{1}{10} + \frac{1}{4}\right] = +\frac{\bar{V}_1}{10} + \frac{\bar{V}_3}{4}$$

$$\bar{V}_2\left[\frac{5}{40} + \frac{4}{40} + \frac{10}{40}\right] = \frac{-28}{10} + \frac{4}{4}$$

$$\bar{V}_2\left[\frac{19}{40}\right] = -2.8 + 1$$ ... (2)

$$\bar{V}_2 \times 19 = -1.8 * 40$$

$$\bar{V}_2 \times 19 = -72$$

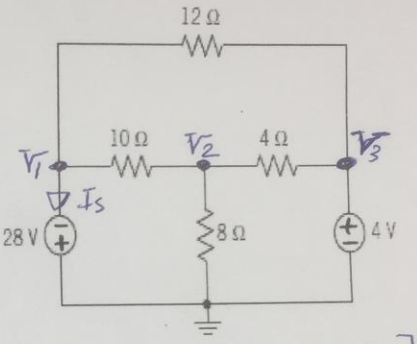
$$\bar{V}_2 = \frac{-72}{19} = -3.79 \text{ volt}$$

Power of 28 volt

$P_{28} = -(28)(I_S)$ ... (1)

KCL at 1 ... (1)

$$I_S + \frac{\bar{V}_1 - \bar{V}_2}{10} + \frac{\bar{V}_1 - \bar{V}_3}{12} = 0$$



$$I_S = -\left[\frac{-28 + 3.79}{10} + \frac{-28 - 4}{12}\right]$$

$$I_S = -[-2.421 + -2.667]$$ ... (1)

$$I_S = -[-5.088] = 5.088 \text{ A}$$

$P_{28} = -(28)(5.088) = -142.46$ watt

$I_1 = 4(I_2+1)$

$I_1 = 4I_2 + 4$

$-I_1 + 4I_2 + 4 = 0$ [1]

$I_1 = 4I_a$

$I_3 = -1\ A$

$I_a = I_2 - I_3$

$I_a = I_2 + 1$

Question 2: (8 marks)

Find power of dependent source , using mesh analysis

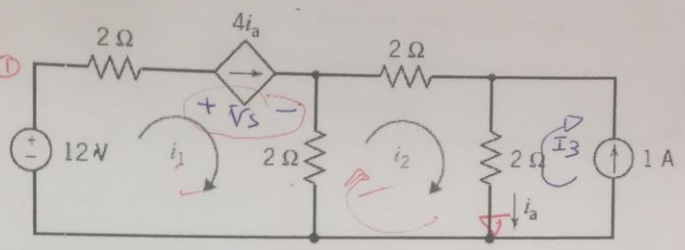
$I_1 = 4I_a$ ---① ans ①

$I_3 = -1\ A$ --② ans ①

$I_a = I_2 - I_3 = I_2 + 1$

$I_1 = 4(I_2+1)$

$I_1 = 4I_2 + 4$ ---②



KVL at mesh 2 ans ①

$2(I_2 - I_1) + 2I_2 + 2(I_2 - I_3) = 0$

$-2I_1 + 6I_2 - 2I_3 = 0$

$-2I_1 + 6I_2 + 2 = 0$ ---③

sub ②´ in ③

$-2(4I_2 + 4) + 6I_2 + 2 = 0$

$-8I_2 - 8 + 6I_2 + 2 = 0$

$-2I_2 - 6 = 0$

$-2I_2 = 6$

$I_2 = -\frac{6}{2} = -3A$ ans ①

$I_1 = 4I_a$ or $= 4x-2 = -8$

$I_a = I_2 + 1 = -3 + 1 = -2A$ ans ①

$I_1 = 4x-3+4 = -12+4 = -8\ A$

Power of dependent source

$P_{dep} = (V_s)(4I_a)$ ans ①

KVL at mesh 1

$-12 + 2I_1 + V_s + 2(I_1 - I_2) = 0$

$-12 + 2(-8) + V_s + 2(-8+3) = 0$

$-12 - 16 + V_s + 2x-5 = 0$ ans ①

$-28 + V_s - 10 = 0$

$V_s = 28 + 10 = 38$ volt

$P_{dep} = (38)(4)(-2) = -304$ ans ①

$= -304$

Question 3: (9 marks) all

Using nodal analysis find power of element? check your results?

From super Node

$\bar{V}_2 - \bar{V}_1 = 16$ (1) $\rightarrow \bar{V}_2 = 16 + \bar{V}_1$

KCL at super Node

$$\frac{\bar{V}_1 - 0}{20} + \frac{\bar{V}_2 - 0}{40} = 4 \quad (1)$$

$$2\bar{V}_1 + \bar{V}_2 = 160$$

$$2\bar{V}_1 + 16 + \bar{V}_1 = 160$$

$$3\bar{V}_1 = 160 - 16$$

$$3\bar{V}_1 = 144$$

$$\bar{V}_1 = \frac{144}{3} = 48 \text{ volt}$$

$$\bar{V}_2 = 16 + 48 = 64 \text{ volt}$$

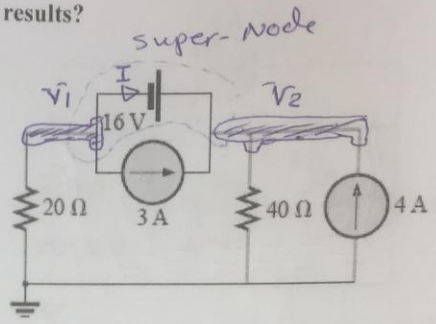
$\bar{V}_1 = 48 V$
$\bar{V}_2 = 64 V$

$$P_{20\Omega} = \frac{\bar{V}_1^2}{20} = \frac{48^2}{20} = 115.2 \text{ W}$$

$$P_{40\Omega} = \frac{\bar{V}_2^2}{40} = \frac{64^2}{40} = 102.4 \text{ W}$$

$$P_{4A} = -4 \times \bar{V}_2 = -4 \times 64 = -256 \text{ W}$$

$$P_{3A} = (3)(\bar{V}_1 - \bar{V}_2) = (3)(48 - 64)$$
$$= 3 \times -16 = -48 \text{ W}$$



$$P_{16V} = -16 * I$$

KCL at ①

$$3 + \frac{\bar{V}_1}{20} + I = 0$$

$$I = -\left(3 + \frac{\bar{V}_1}{20}\right)$$

$$I = -\left(3 + \frac{48}{20}\right) = -5.4 A$$

$$P_{16V} = -16 \times -5.4 = 86.4 \text{ W}$$

$\sum p_i = 0$ check

$= 115.2 + 102.4 - 256 - 48 + 86.4$

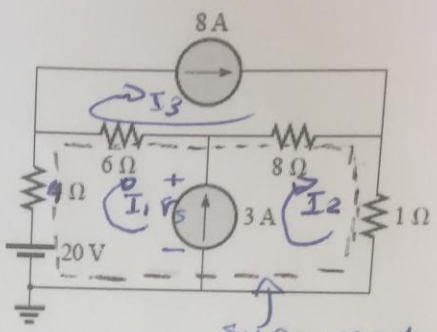
$=$ zero

$\bar{V}_1 = 48 V$ — (1)
$\bar{V}_2 = 64 V$ — (1)
$P_{20\Omega} = 115.2 W$ — (1)
$P_{40\Omega} = 102.4 W$ — (1)
$P_{4A} = -256 W$ — (1)
$P_{3A} = -48 W$ — (1)
$P_{16V} = 86.4 W$ → (1)

End of Questions

Question 2: (8 marks)

Using mesh analysis find power of 3 A current source



$I_3 = 8$ A ---- (1)

From super-mesh

$I_2 - I_1 = 3 \rightarrow I_2 = 3 + I_1$ (1)

KVL ab super mesh

$-20 + 4I_1 + 6(I_1 - I_3) + 8(I_2 - I_3) + 1.I_2 = 0$

$10I_1 + 9I_2 - 14I_3 = 20$ (1)

$10I_1 + 9(3 + I_1) - 14 \times 8 = 20$

$19I_1 + 27 - 112 = 20$

$19I_1 - 85 = 20$

$19I_1 = 20 + 85$

$19I_1 = 105$

$I_1 = \frac{105}{19} = 5.526$ A

$I_2 = 3 + 5.526 = 8.526$ A

$I_1 = 5.526$ A (1)

$I_2 = 8.526$ A (1)

$I_3 = 8$ A (1)

$P_{3A} = -(3)(V_s)$

KVL ab Loop 1

$-20 + 4I_1 + 6(I_1 - I_3) + V_s = 0$

$-20 + 10I_1 - 6I_3 + V_s = 0$

$-20 + 10(5.526) - 6 \times 8 + V_s = 0$

$-20 + 55.26 - 48 + V_s = 0$

$-12.74 + V_s = 0$ (1)

$V_s = 12.74$ volt

$P_{3A} = -3 \times 12.74 = -38.22$ W (1)