

ELECTRICAL ENGINEERING DEPARTMENT
CALIFORNIA POLYTECHNIC STATE UNIVERSITY

EE 112 Electric Circuit Analysis I

EXAM 2

Winter 2004

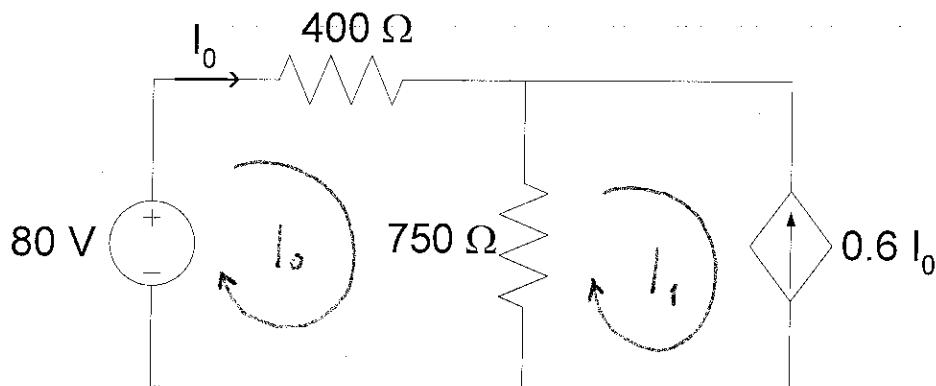
Name: _____ Last 4 digits of Student ID: _____

Section #: _____

1 (6)	2 (6)	3 (6)	4 (7)	Total (25)

PROBLEM #1

Use **Mesh Analysis** to determine the current I_0 in the network shown below.



KVL for mesh with I_0 :

$$(400 + 750) I_0 - 750 I_1 = 80 \quad (1)$$

In mesh with I_1 :

$$I_1 = -0.6 I_0 \quad (2)$$

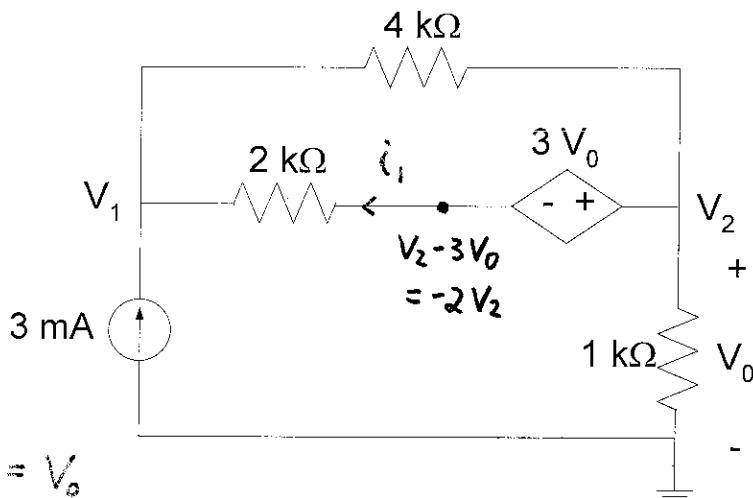
Substitute (2) in (1)

$$1150 I_0 + 750 \times 0.6 I_0 = 80$$

$$I_0 = \frac{80}{1150 + 450} = \frac{80}{1600} = \frac{1}{20} = 50 \text{ mA} \quad 2$$

PROBLEM #2

For the circuit below, find V_1 and V_2 using **nodal analysis**.



$$V_2 = V_0$$

$$i_1 = \frac{V_2 - 3V_0 - V_1}{2} = \frac{-2V_2 - V_1}{2}$$

KCL @ node 1:

$$3 + \frac{-2V_2 - V_1}{2} + \frac{V_2 - V_1}{4} = 0 \quad (1)$$

KCL @ node 2:

$$\frac{V_2 - V_1}{4} + \frac{-2V_2 - V_1}{2} + \frac{V_2}{1} = 0 \quad (2)$$

$$(1) \rightarrow 12 - 4V_2 - 2V_1 + V_2 - V_1 = 0$$

$$3V_1 + 3V_2 = 12$$

$$V_1 + V_2 = 4 \quad (3)$$

$$(2) \rightarrow V_2 - V_1 - 4V_2 - 2V_1 + 4V_2 = 0$$

$$3V_1 = V_2 \quad (4)$$

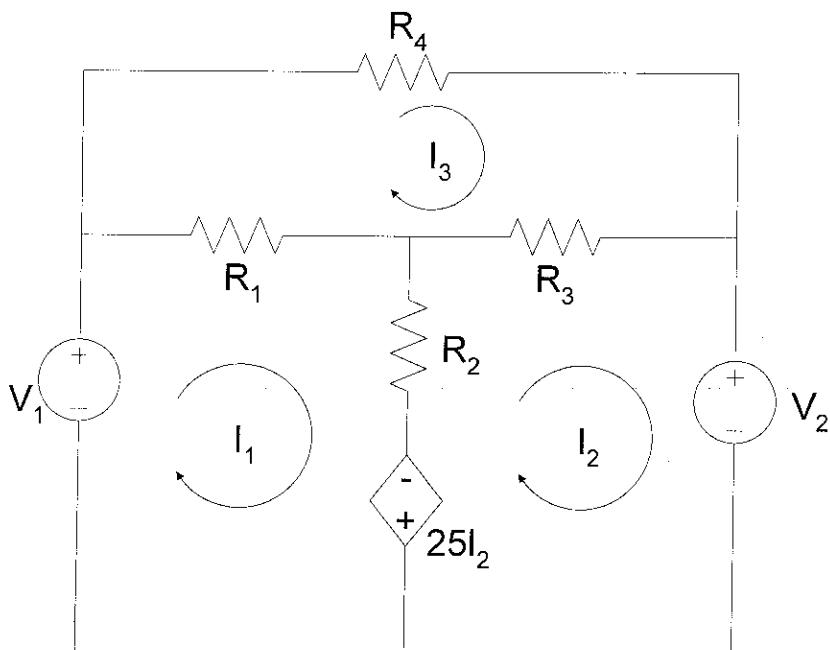
from (3), (4): $\begin{cases} V_1 = 1V \\ V_2 = 3V \end{cases}$

PROBLEM #3

The mesh equations for the circuit below are

$$\begin{bmatrix} 20 & -40 & -5 \\ -15 & 65 & -25 \\ -5 & -25 & 35 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ -V_2 \\ 0 \end{bmatrix}$$

Find R_1 , R_2 , R_3 , and R_4 .



KVL for mesh with I_1 :

$$R_1(I_1 - I_3) + R_2(I_1 - I_2) - 25I_2 = V_1$$

$$(R_1 + R_2)I_1 - (R_2 + 25)I_2 - R_1I_3 = V_1$$

Compare with 1st row in matrix: $\begin{cases} R_1 + R_2 = 20 \\ R_2 + 25 = 40 \\ R_1 = 5 \end{cases} \rightarrow \begin{cases} R_1 = 5 \Omega \\ R_2 = 15 \Omega \end{cases}$

KVL for mesh with I_2 :

$$25I_2 + R_2(I_2 - I_1) + R_3(I_2 - I_3) = -V_2$$

$$-R_2I_1 + (25 + R_2 + R_3)I_2 - R_3I_3 = -V_2$$

Compare with 2nd row in matrix: $\begin{cases} R_2 = 15 \\ 25 + R_2 + R_3 = 65 \\ R_3 = 25 \end{cases} \rightarrow \begin{cases} R_2 = 25 \Omega \\ R_3 = 25 \Omega \end{cases}$

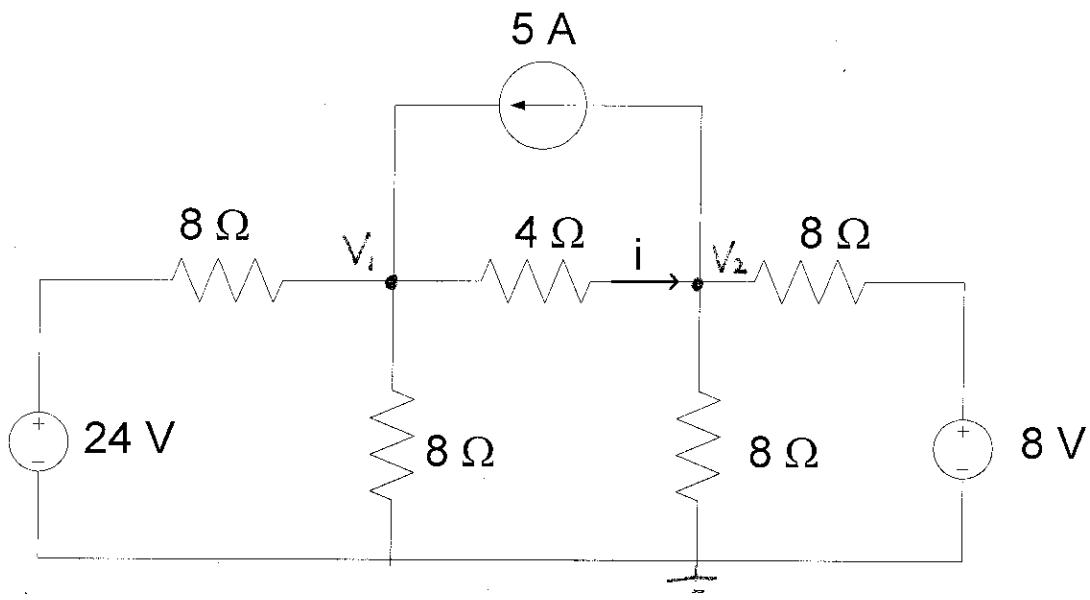
KVL for mesh 3:

$$(R_1 + R_3 + R_4)I_3 - R_1I_1 - R_3I_2 = 0$$

Compare with 3rd row in matrix: $\begin{cases} R_1 + R_3 + R_4 = 35 \\ R_1 = 5 \Omega \\ R_3 = 25 \Omega \end{cases} \rightarrow \begin{cases} R_4 = 5 \Omega \end{cases}$

PROBLEM #4

Using **nodal analysis**, find i .



KCL @ node 1 :

$$\frac{24-V_1}{8} - \frac{V_1}{8} + \frac{V_2-V_1}{4} + 5 = 0 \quad 2$$

$$24-V_1 - V_1 + 2V_2 - 2V_1 + 40 = 0$$

$$4V_1 - 2V_2 = 64$$

$$2V_1 - V_2 = 32 \quad (1)$$

KCL @ node 2 :

$$\frac{V_1-V_2}{4} - \frac{V_2}{8} + \frac{8-V_2}{8} - 5 = 0 \quad 2$$

$$2V_1 - 2V_2 - V_2 + 8 - V_2 - 40 = 0$$

$$2V_1 - 4V_2 = 32 \quad (2)$$

$$4 \quad (1) - (2): \quad 3V_2 = 0$$

$$\begin{cases} V_2 = 0 \text{ V} \\ V_1 = 16 \text{ V} \end{cases}$$

$$i = \frac{V_1-V_2}{4} = \underline{4 \text{ A}} \quad 2$$