Assignment #4 Due Tue Feb. 11, 11:59 PM

Midterm 1 Scores posted on Canvas
Hi 100/100 Lo 31/100
Avg. 77.4/100 Median 79/100

Please collect exam during office hours or exam pickup time 2-4pm Today KEC 3114

Node voltage (nodal) analysis

\[ v_1 = v_S \]

The unknown node voltage is \( v_2 \)

KCL @ node 2: \[ -\left(\frac{v_1 - v_2}{R_2}\right) - i_S + \frac{v_2}{R_3} = 0 \]

Ex. \( v_1 = 7V \)

\[ v_3 = v_2 + 3 \]

3V independent voltage source is connected between 2 non-reference nodes.

KCL @ node 2: \[ -\left(\frac{v_1 - v_2}{4}\right) + \frac{v_2}{3} + i = 0 \]

KCL @ node 3: \[ -i + \frac{v_3}{2} + \frac{v_2}{6} = 0 \]

KCL @ node 2/3: \[ -\left(\frac{v_1 - v_2}{4}\right) + v_2 + \frac{v_3}{3} + \frac{v_2}{2} + \frac{v_3}{6} = 0 \]

This is the KCL for the supernode with unknowns \( v_2 \) and \( v_3 \). Combined with the constraint \( v_3 = v_2 + 3 \), we have 2 equations in 2 unknowns.

Write KCL equation associated with supernode + constraint equation
Mesh current (mesh) analysis

Systematic application of KVL

What is a mesh?
A mesh is a loop that does not contain any other loops within it, i.e., an independent loop

How many loops? 3
How many meshes? 2

1. Find and label all mesh currents (take clockwise direction)
2. Apply KVL in each mesh $\sum v = 0$

KVL in mesh 1: $R_1 i_1 + R_3 (i_1 - i_2) = V_3 = 0$

KVL in mesh 2: $R_2 i_2 + R_4 i_2 + R_3 (i_2 - i_1) = 0$

$-(R_1 + R_3) i_1 - R_3 i_2 = V_5$
$-R_3 i_1 + (R_4 + R_3 + R_4) i_2 = 0$

3. Solve the system of equations for the mesh currents

Ex:
KVL for mesh 1:
$4i_1 + 2(i_1 - i_2) - 5 = 0$

Mesh 2 cannot write KVL $i_2 = 3A$

There is only 1 unknown $i_1 = 1.67 A$
Ex:
1. Identify & label mesh currents
2. Write KVL

**KVL Mesh 1:**

\[ i_1 + 2(i_1 - i_2) + V - 7V = 0 \]

Voltage drop across indep current source

**KVL for super mesh:**

\[ i_1 + 3i_2 + 4i_2 + 9 - 7 = 0 \]

\[ i_2 - i_1 = 6A \]