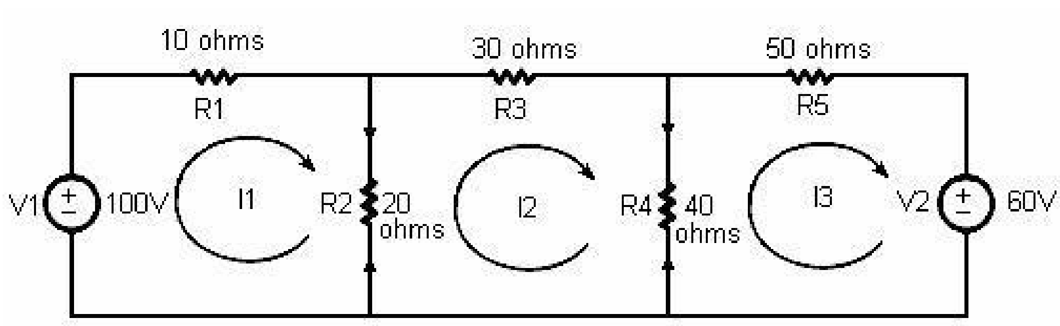
ECE 201: Linear Circuit Analysis I:
Chapter 4: Mesh Analysis
MATLAB EXAMPLES

Example 1

Below is a particular circuit that you decide to solve using Mesh Analysis. We can write the equations for the circuit, but so far, we don't know how to solve them. One way is using Cramer's rule, another way is using your TI Calculator. However, we are going to use MATLAB to solve this circuit.



Mesh Analysis

KVL & Ohms' Law @ Loop 1

$$-V_1 + i_1R_1 + R_2(i_1 - i_2) = 0$$

$$-100 + 10i_1 + 20(i_1 - i_2) = 0$$

KVL & Ohms' Law @ Loop 2

$$R_2(i_2 - i_1) + i_2R_3 + R_4(i_2 - i_3) = 0$$

$$20(i_2 - i_1) + 30i_2 + 40(i_2 - i_3) = 0$$

KVL & Ohms' Law @ Loop 3

$$R_4(i_3 - i_2) + i_3R_5 + V_2 = 0$$

$$40(i_3 - i_2) + 50i_3 + 60 = 0$$

$\rightarrow$

$$\begin{bmatrix} R_1 + R_2 & -R_2 & 0 \\ -R_2 & R_2 + R_3 + R_4 & -R_4 \\ 0 & -R_4 & R_4 + R_5 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} V_1 \\ 0 \\ -V_2 \end{bmatrix}$$

$$\begin{bmatrix} (10 + 20) & -20 & 0 \\ -20 & 20 + 30 + 40 & -40 \\ 0 & -40 & 40 + 50 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \\ -60 \end{bmatrix}$$

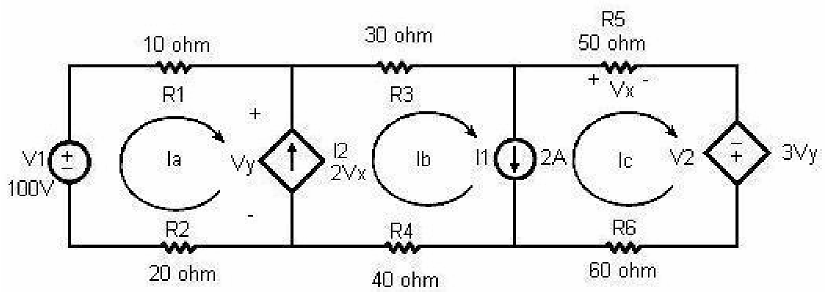
$$\begin{bmatrix} 30 & -20 & 0 \\ -20 & 90 & -40 \\ 0 & -40 & 90 \end{bmatrix} \begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 100 \\ 0 \\ -60 \end{bmatrix}$$

$$\begin{bmatrix} i_1 \\ i_2 \\ i_3 \end{bmatrix} = \begin{bmatrix} 3.79 \\ 0.679 \\ -0.3647 \end{bmatrix}$$

```
% ECE 201  Linear Circuit Analysis I
% Lecture Notes MATLAB Program
% Circuit Example 1

% Initializing given variables
    v1 = 100.0;             % Volts
    v2 = 60.0;              % Volts
    r1 = 10.0;              % Ohms
    r2 = 20.0;              % Ohms
    r3 = 30.0;              % Ohms
    r4 = 40.0;              % Ohms
    r5 = 50.0;              % Ohms

% Assign appropriate values to row 1 of Matrix A
%          * using equation  AX = B
    A(1,1) = r1 + r2;                         % 1st column of A
    A(1,2) = ( - r2 );                        % 2nd column of A
    A(1,3) = 0.0;                             % 3rd column of A

% Assign appropriate values to row 2 of Matrix A
    A(2,1) = ( - r2 );                        % 1st column of A
    A(2,2) = r2 + r3  + r4;                   % 2nd column of A
    A(2,3) = ( - r4 );                        % 3rd column of A

% Assign appropriate values to row 3 of Matrix A
    A(3,1) = 0.0;                             % 1st column of A
    A(3,2) = ( - r4 );                        % 2nd column of A
    A(3,3) = r4 + r5;                         % 3rd column of A
% Assign appropriate values to column 1 of Matrix B
    B(1,1) = v1;                              % 1st row of B
    B(2,1) = 0;                               % 2nd row of B
    B(3,1) = ( - v2 );                        % 3rd row of B
% Calculate matrix X by solving AX = B for X
    X = inv(A) * B;

% Assign appropriate values of Matrix X to their
% respective currents
    i1 = X(1,1);
    i2 = X(2,1);
    i3 = X(3,1);

% Display results
    fprintf('\n');
    fprintf('i1 = %f A\n', i1);
    fprintf('i2 = %f A\n', i2);
    fprintf('i3 = %f A\n', i3);

% Output
%
%   i1 = 3.786164 A
%   i2 = 0.679245 A
%   i3 = -0.364780 A
```

Figure 1: Program for Above Circuit

Example 2:




```
% ECE 201  Linear Circuit Analysis I
% Lecture Notes MATLAB Program
% Circuit Example 2

% Initializing given variables
    v1 = 100.0;             % Volts
    i1 = 2.0;               % Amps
    r1 = 10.0;              % Ohms
    r2 = 20.0;              % Ohms
    r3 = 30.0;              % Ohms
    r4 = 40.0;              % Ohms
    r5 = 50.0;              % Ohms
    r6 = 60.0;              % Ohms
    v2 = 0.0;               % Volts
    i2 = 0.0;               % Amps
    mult_v2 = 3.0;          % Constant Multiplier
    mult_i2 = 2.0;          % Constant Multiplier

% Assign appropriate values to row 1 of Matrix A
%           * using equation  AX = B
    A(1,1) = -1.0;                      % 1st column of A
    A(1,2) = 1.0;                       % 2nd column of A
    A(1,3) = - ( r5 * mult_i2 );        % 3rd column of A

% Assign appropriate values to row 2 of Matrix A
    A(2,1) = 0.0;                       % 1st column of A
    A(2,2) = 1.0;                       % 2nd column of A
    A(2,3) = - 1.0;                     % 3rd column of A

% Assign appropriate values to row 3 of Matrix A
    A(3,1) = r1 + ( mult_v2 * r1 );              % 1st column of A
    A(3,1) = A(3,1) + ( mult_v2 * r2 ) + r2;     % 1st column of A cont..
    A(3,2) = r3 + r4;                            % 2nd column of A
    A(3,3) = r5 + r6;                            % 3rd column of A

% Assign appropriate values to column 1 of Matrix B
    B(1,1) = 0.0;                              % 1st row of B
    B(2,1) = i1;                               % 2nd row of B
    B(3,1) = ( mult_v2 * v1 ) + v1;            % 3rd row of B

% Calculate matrix X by solving AX = B for X
    X = inv(A) * B;

% Assign appropriate values of Matrix X to their respective currents
    i_a = X(1,1);
    i_b = X(2,1);
    i_c = X(3,1);
```

```
% Calculate necessary voltages
   v_y = v1 - ( ( r1 + r2 ) * i_a );      % Calculate v_y using KVL
   v_x = r5 * i_c;                        % Calculate v_x using Ohm's Law
```

```
% Display results
    fprintf('\n');
    fprintf('i_a = %f A\n', i_a);
    fprintf('i_b = %f A\n', i_b);
    fprintf('i_c = %f A\n', i_c);
    fprintf('v_x = %f V\n', v_x);
    fprintf('v_y = %f V\n', v_y);

% Output
%
%   i_a = 2.169231 A
%   i_b = 1.998291 A
%   i_c = -0.001709 A
%   v_x = -0.085470 V
%   v_y = 34.923077 V
```

Figure 2: Program for Circuit in Example 2