



a) Draw the directed graph of the circuit.

b) Using Mesh-Matrix (\underline{M}) and mesh currents (i_1, i_2), express the branch currents.

c) Write the branch current and branch voltage relations in the matrix form as shown below:

$$\underline{V} = \underline{R} \underline{i} + \underline{V}_s$$

↖ Branch voltages ↙ Branch currents ↘ voltage sources

d) Find mesh currents using Mesh matrix and voltage source vector and \underline{R} matrix.

e) Find I_1, I_2, I_3 from mesh currents.
 Answer: $(I_1 = I_2 = 1A; I_3 = 0A)$.

② a) Draw the dual graph and circuit of the network given in problem 1. Use the dual circuit for the rest of the problem.

b) Using reduced incidence matrix (\underline{A}) and node voltages (e_1, e_2) express branch voltages. (Make sure to select the Datum node such that \underline{A} matrix is identical to the \underline{M} matrix of problem 1)

c) Write branch current and branch voltages relation in matrix form as shown below:

$$\underline{i} = \underline{Y} \underline{u} + \underline{i}_s$$

← branch currents ← branch voltages ← current sources

d) Find node voltages using \underline{A} , \underline{Y} matrices and \underline{i}_s vector.

e) Find branch voltages of dual circuit.