# Tutorial 2

## Mesh Current and Nodal Voltage Analysis

1.  Write the mesh current equations for $I_1$, $I_2$ and $I_3$ in matrix form by inspection for the network shown in Figure 1.

    **Ans:** $\begin{bmatrix} 5 - j5 & j5 & 4 \\ j5 & 5 & j5 \\ 4 & j5 & 5 + j5 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10\angle 0^0 \\ 0 \\ 20\angle 90^0 \end{bmatrix}$

2.  Loop currents are shown in the network of Figure 2. Write the matrix equation by inspection and solve for $I_1$, $I_2$ and $I_3$.
    **Ans: $I_1 = 3.55$ A, $I_2 = -1.98$ A, $I_3 = -2.98$ A**

3.  Find the node voltages $V_1$ and $V_2$ in the network of Figure 2 and with them verify the three currents obtained in Problem 2.
    **Ans: $V_1 = 7.11$ V, $V_2 = -3.96$ V**

4.  Obtain the node voltage $V_1$ in the network shown in Figure 3.
    **Ans: $74.9 \angle 62.84^o$ V**

5.  Write the nodal voltage equations for $V_1$, $V_2$ and $V_3$ in matrix form by inspection for the network shown in Figure 4.
    **Ans:**

    $$\begin{bmatrix} 0.55 + j0.25 & -0.25 - j0.25 & -0.1 \\ -0.25 - j0.25 & 0.375 + j0.05 & -0.125 \\ -0.1 & -0.125 & 0.325 + j0.2 \end{bmatrix} \begin{bmatrix} V_1 \\ V_2 \\ V_3 \end{bmatrix} = \begin{bmatrix} -2.5 - j2.5 \\ 3.037 + j2.813 \\ -0.541 - j0.313 \end{bmatrix}$$

6.  For the circuit shown in Figure 5
    (a)   Write down in matrix form, by inspection, the node voltage equations required to calculate the voltages at nodes A and B, with respect to the ground node C.
    (b)   By solving the matrix equation in (a), calculate the current flowing in the 1000 $\Omega$ resistor.
    (c)   Write down in matrix form, by inspection, the mesh current equations required to calculate the currents $I_1$, $I_2$, and $I_3$.
    (d)   By solving the matrix equation in (c), show that current $I_2$ is the same as obtained in (b).
    **Ans:**

    $\begin{bmatrix} 0.103 & -0.001 \\ -0.001 & 0.008 \end{bmatrix} \begin{bmatrix} V_A \\ V_B \end{bmatrix} = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$, $\qquad \begin{bmatrix} 510 & 10 & 0 \\ 10 & 1510 & -500 \\ 0 & -500 & 700 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 10 \\ 10 \\ 0 \end{bmatrix}$

    $V_A = 9.72V, V_B = 1.215V$

    $I_{1000\Omega} = I_2 = 8.5mA$
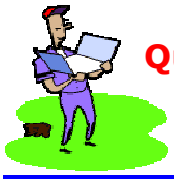
**Quiz** – 2 questions
(Mesh Analysis)



Figure 1



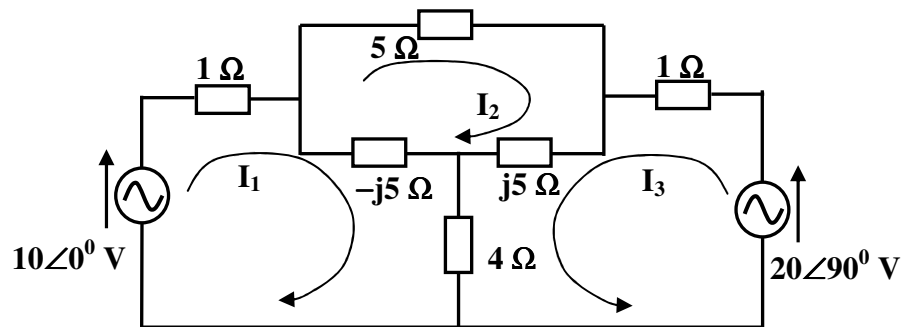**Figure 2**



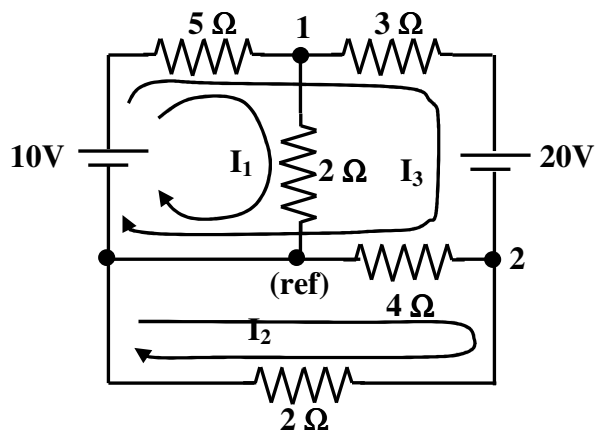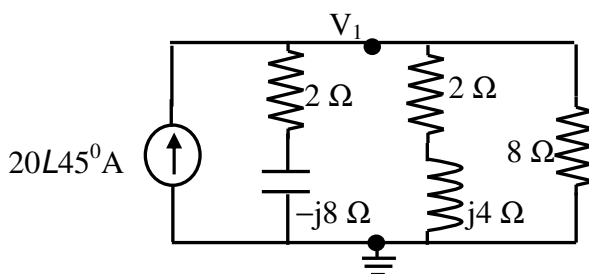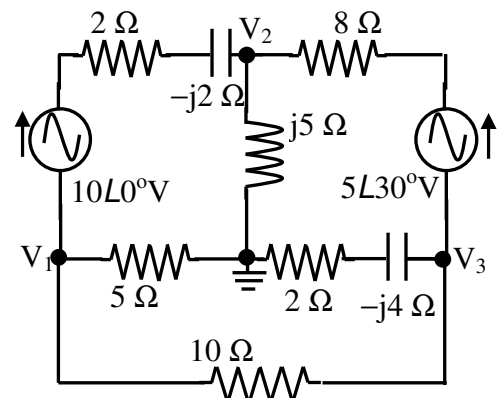**Figure 3**



**Figure 4**



**Figure 5**