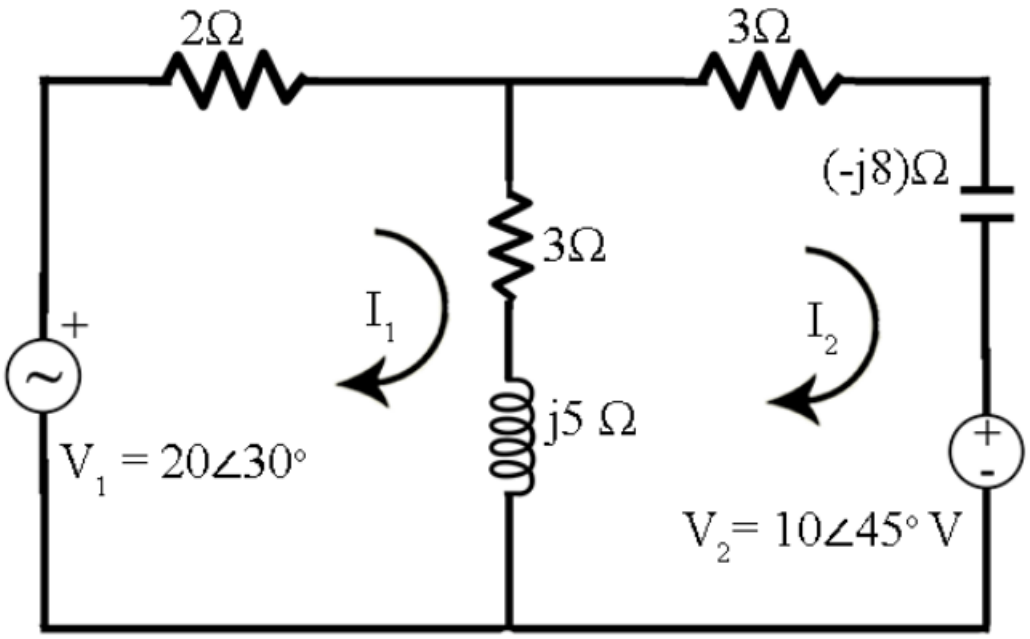
MESH ANALYSIS

Using mesh current analysis, find the drop in the capacitor for the network shown in figure



Solution:

Let us first designated the mesh current as I_1 and I_2. Application of loop analysis yields

$$(2+3+j5)I_1 - (3+j5)I_2 = V_1$$

or $$(5+j5)I_1 - (3+j5)I_2 = V_1 = 20\angle 30^\circ V \qquad \ldots(1)$$

and $$(3-j8+3+j5)I_2 - (3+j5)I_1 = 10\angle 45^\circ$$

or $$(6-j3)I_2 - (3+j5)I_1 = 10\angle 45^\circ \qquad \ldots(2)$$

In matrix form equation (1) and (2) are rearranged as

$$\begin{bmatrix} (5+j5) & -(3+j5) \\ -(3+j5) & (6-j3) \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \end{bmatrix} = \begin{bmatrix} 20\angle 30^\circ \\ 10\angle 45^\circ \end{bmatrix}$$

$$\therefore I_2 = \frac{\begin{vmatrix} (5+j5) & 20\angle 30^\circ \\ -(3+j5) & 10\angle 45^\circ \end{vmatrix}}{\begin{vmatrix} (5+j5) & -(3+j5) \\ -(3+j5) & (6-j3) \end{vmatrix}}$$

$$= \frac{\begin{vmatrix} 7.07\angle 45^\circ & 20\angle 30^\circ \\ -5.83\angle 59^\circ & 10\angle 45^\circ \end{vmatrix}}{\begin{vmatrix} 7.07\angle 45^\circ & -5.83\angle 59^\circ \\ -5.83\angle 59^\circ & 6.71\angle -26.56^\circ \end{vmatrix}}$$

$$= \frac{70.7\angle 90^\circ + 116.6\angle 89^\circ}{47.44\angle 18.44^\circ - 33.99\angle 118^\circ}$$

$$= \frac{j70.7 + 2.03 + j116.58}{45 + j15 + 15.96 - j30} = \frac{2.03 + j187.28}{60.96 - j15}$$

$$\frac{187.29\angle 89.38^\circ}{62.78\angle -13.81^\circ} = 2.98\angle 103.29^\circ A.$$

- Drop in the capacitor

$$= I_2(-j8) = 23.84\angle 13.19^\circ V.$$