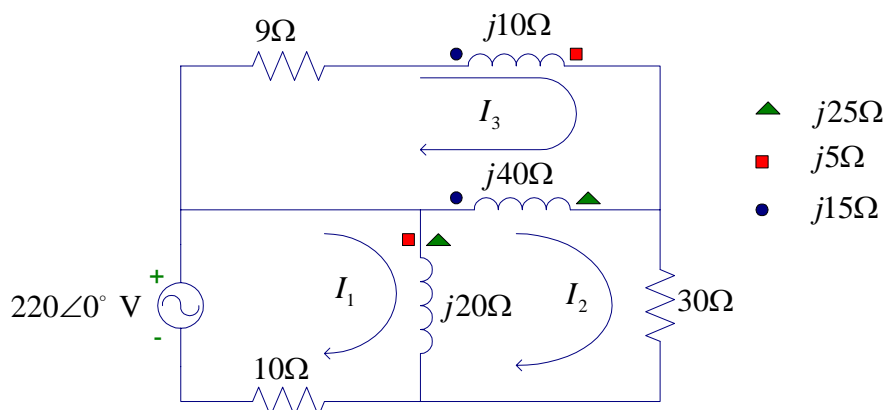


**Exercise on writing mesh equations
in a magnetically coupled circuit
EE-230 (H. Saadat)**

For the circuit shown write the mesh equations. Solve the equations and obtain the phasor values of currents.



$$\begin{aligned} \text{Mesh \#1} \quad & j20(I_1 - I_2) - j25(I_2 - I_3) - j5I_3 + 10I_1 = 220\angle 0^\circ \\ \text{Mesh \#2} \quad & 30I_2 + j20(I_2 - I_1) + j25(I_2 - I_3) + j5I_3 + j40(I_2 - I_3) - j25(I_1 - I_2) + j15I_3 = 0 \\ \text{Mesh\#3} \quad & (9 + j10)I_3 - j15(I_3 - I_2) - j5(I_1 - I_2) + j40(I_3 - I_2) + j25(I_1 - I_2) - j15I_3 = 0 \end{aligned}$$

Reducing the above equations we get

$$\begin{aligned} (10 + j20)I_1 - j45I_2 + j20I_3 &= 220\angle 0^\circ \\ -j45I_1 + (30 + j110)I_2 - j45I_3 &= 0 \\ j20I_1 - j45I_2 + (9 + j20)I_3 &= 0 \end{aligned}$$

or in matrix notation we have

$$\begin{bmatrix} 10 + j20 & -j45 & j20 \\ -j45 & 30 + j110 & -j45 \\ j20 & -j45 & 9 + j20 \end{bmatrix} \begin{bmatrix} I_1 \\ I_2 \\ I_3 \end{bmatrix} = \begin{bmatrix} 220 + j0 \\ 0 \\ 0 \end{bmatrix}$$

Using MATLAB the solution is

$$\begin{aligned} I_1 &= 16.4447\angle -5.1000^\circ \text{ A} \\ I_2 &= 4.1813\angle -1.6807^\circ \text{ A} \\ I_3 &= 6.4526\angle -165.420^\circ \text{ A} \end{aligned}$$

We use the following statements:

```
Z = [10+20j    -45j    20j  
     -45j    30+110j   -45j  
     20j     -45j    9+20j];  
V = [220; 0; 0];  
I = inv(Z)*V    % Solution in Rectangular form  
disp(['      Mag.   Phase Degree'])  
disp([abs(I), angle(I)*180/pi]) % Polar form
```

The result is

```
I =  
    16.3796 - 1.4618i  
     4.1795 - 0.1226i  
    -6.2448 - 1.6243i  
  
      Mag.   Phase Degree  
16.4447   -5.1000  
 4.1813   -1.6807  
 6.4526  -165.4205
```