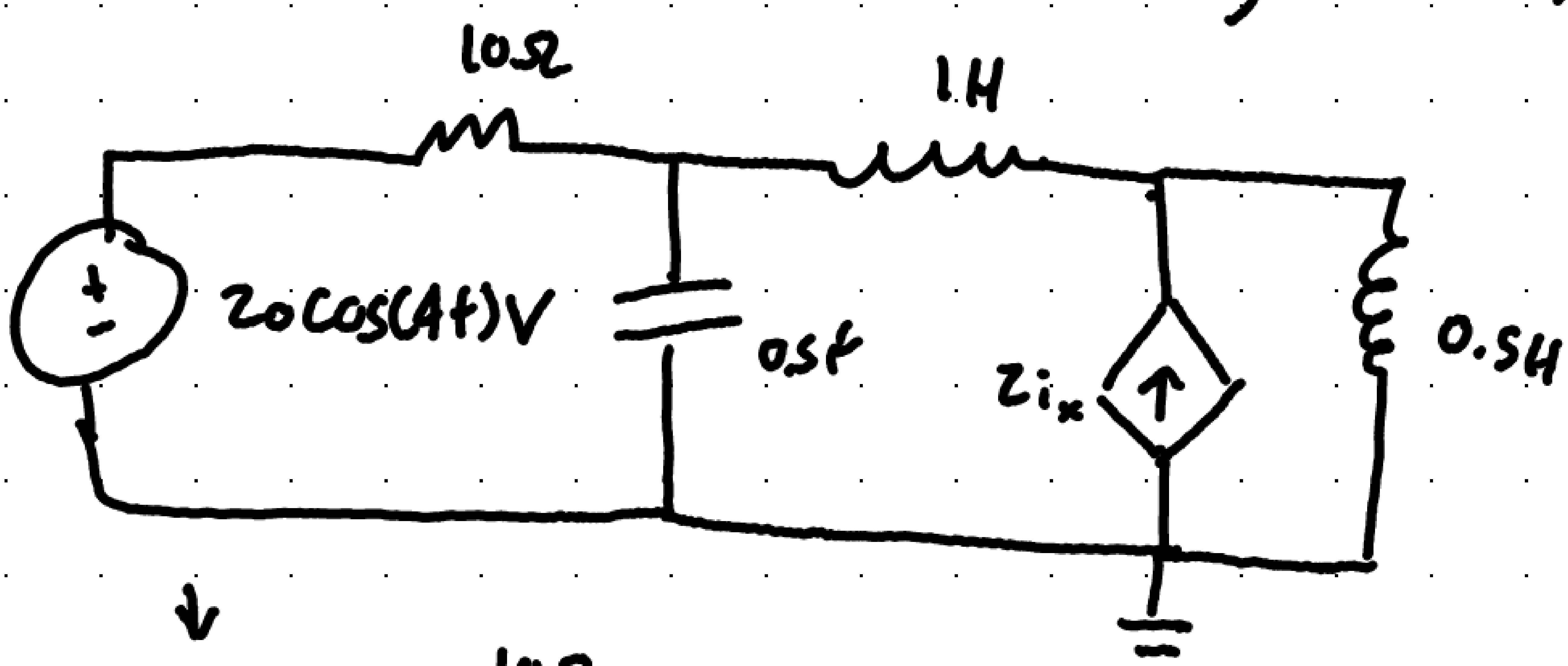
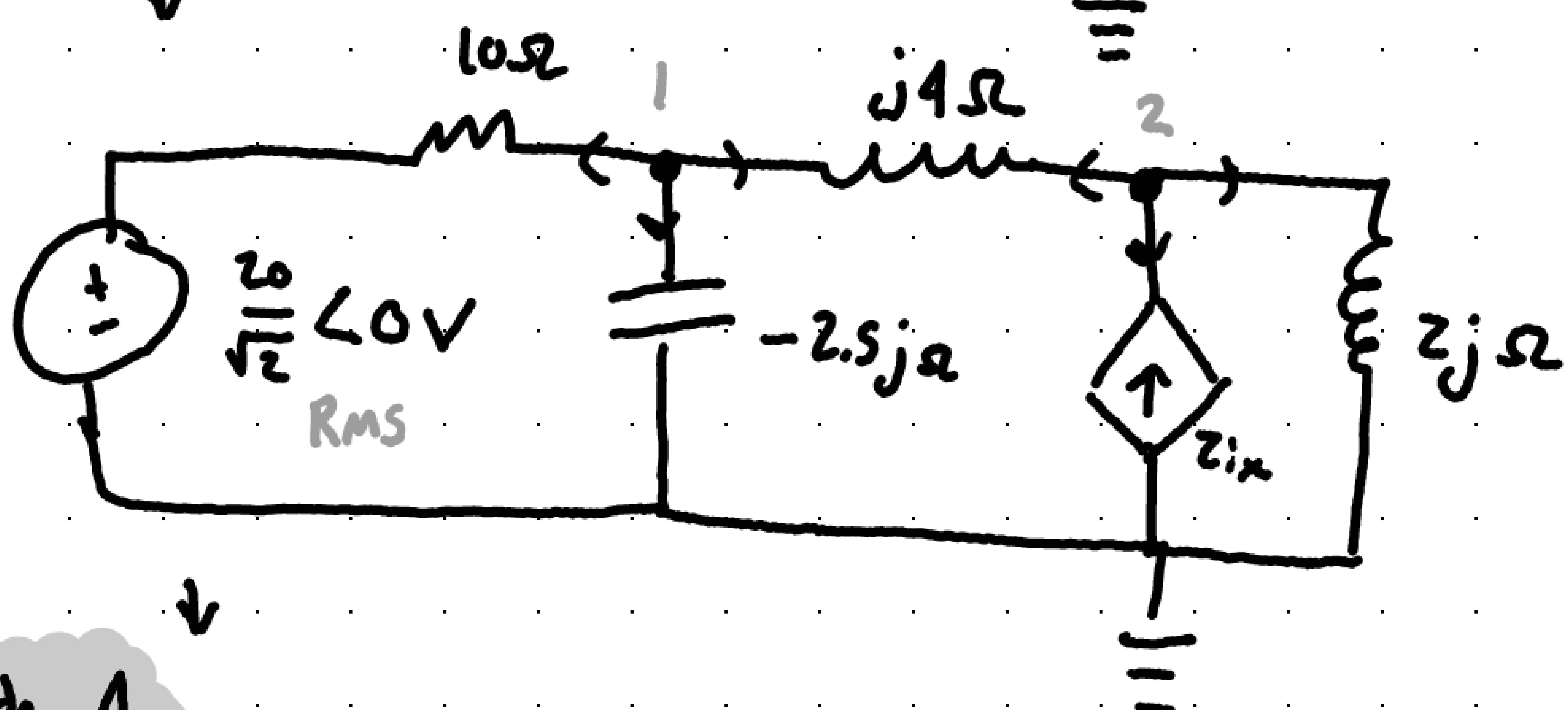
Circuit Analysis : ECED 2001 Lecture 5

Nodal Analysis in AC:

Find I_x in the circuit by using nodal Analysis



↓



↓

Node 1

$$\frac{V_1 - \frac{20}{\sqrt{2}}\angle 0}{10} + \frac{V_1}{-2.5j\Omega} + \frac{V_1 - V_2}{4j\Omega} = 0$$

$$i_x = \frac{V_1}{-2.5j}$$

Node 2

$$\frac{V_2 - V_1}{4j\Omega} + \frac{V_2}{2j\Omega} - 2\left(\frac{V_1}{-2.5j}\right) = 0$$

$$(1+1.5)V_1 + 2.5jV_2 = \frac{20}{\sqrt{2}}\angle 0V$$ Eqn 1

$$-V_1 - 8j\left(\frac{V_1}{-2.5j}\right) + 3V_2 = 0$$ Eqn 2

$$\begin{bmatrix} 1+1.5j & 2.5j \\ 2.2 & 3 \end{bmatrix}\begin{bmatrix} V_1 \\ V_2 \end{bmatrix} = \begin{bmatrix} \frac{20}{\sqrt{2}}\angle 0V \\ 0 \end{bmatrix}$$

Cramer's Rule

Determinant

$$V_1 = \frac{D_1}{D} \qquad V_2 = \frac{D_2}{D}$$

$$D_1 = \begin{bmatrix} \frac{20}{\sqrt{2}}\angle 0 & 2.5j \\ 0 & 3 \end{bmatrix} =$$

Solve, and fill in

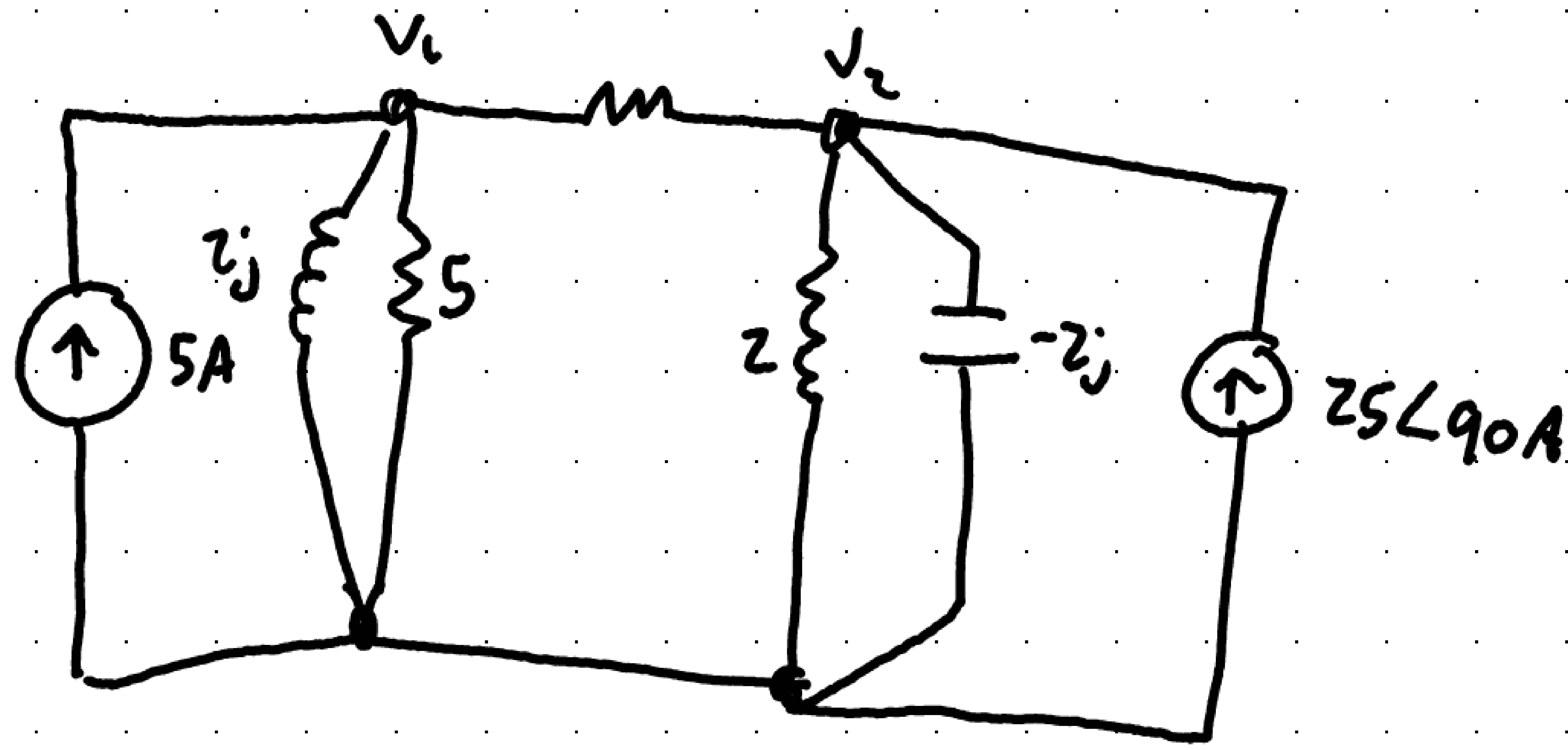
$$D_2 = \begin{bmatrix} 1+1.5j & \frac{20}{\sqrt{2}}\angle 0 \\ 2.2 & 0 \end{bmatrix} =$$

Remember to convert back to time domain.

$$D = 3 - j$$

Nodal Matrix by inspection

- Load into matrix by Admittance



$$\overset{A}{\begin{bmatrix} \frac{1}{5}+\frac{1}{4}+\frac{1}{j2} & -\frac{1}{4} \\ -\frac{1}{4} & \frac{1}{2}+\frac{1}{4}+\frac{1}{-j2} \end{bmatrix}} \overset{x}{\begin{bmatrix} V_1 \\ V_2 \end{bmatrix}} \overset{=}{=} \overset{B}{\begin{bmatrix} +5 \\ 25\angle 90 \end{bmatrix}}$$

Can use Cramer's Rule to Solve this, just as before.

Thev & Norton

- Replace Voltage Sources with Short Circuits, and Current Sources with Open Circuits