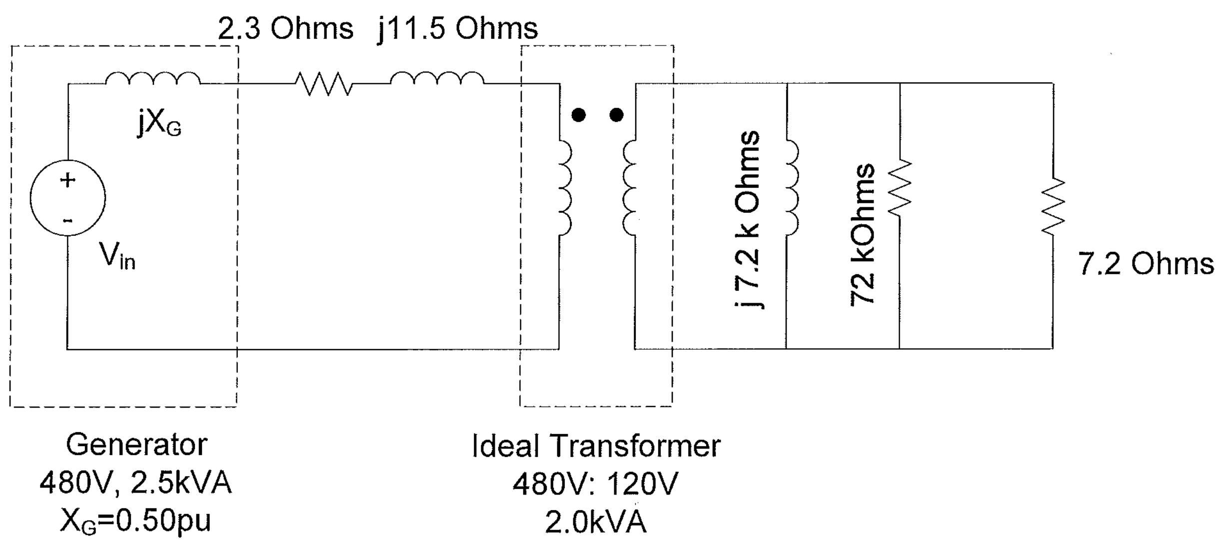
ECE 320
Quiz 5
Per Unit

NAME ______________________________

1. (6 points) For the transformer circuit shown below:
   a. Specify the base for each region of the circuit.
   b. Convert all the impedances to per unit on the base that you specify.
   c. Draw the per unit circuit that your analysis creates.

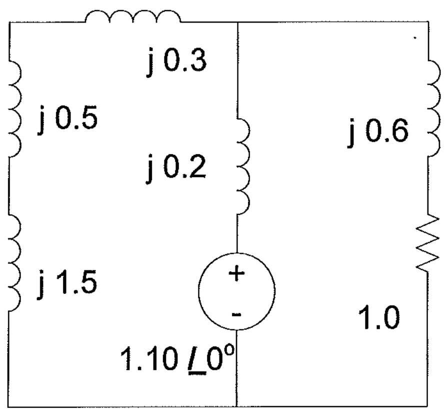


There is more on the other side of this page.

ECE 320
Quiz 5
Per Unit

NAME ______________________________

2. (4 points) For the per unit circuit shown below, find the real power dissipated in the resistor.

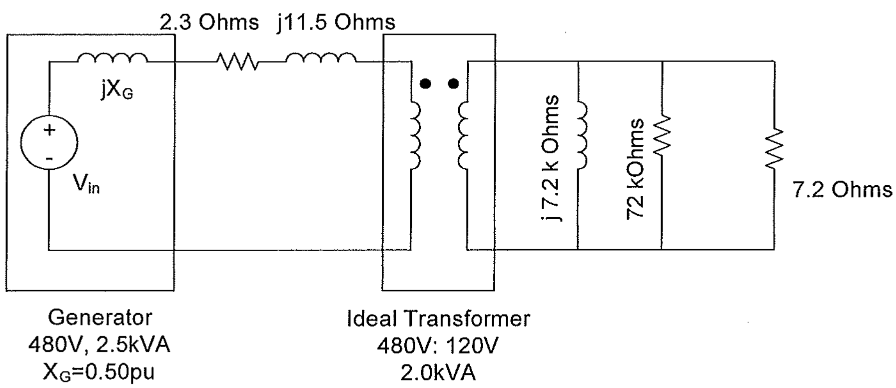


There is more on the other side of this page.

ECE 320
Quiz 5
Per Unit

NAME ______________________

1. (6 points) For the transformer circuit shown below:
   a. Specify the base for each region of the circuit.
   b. Convert all the impedances to per unit on the base that you specify.
   c. Draw the per unit circuit that your analysis creates.



Select a base of 480V : 120V, 2.0kVA

$$Z_{baseR} := \frac{(120\cdot V)^2}{2000\cdot V\cdot A} = 7.2\Omega \qquad Z_{baseL} := \frac{(480\cdot V)^2}{2000\cdot V\cdot A} = 115.2\Omega$$

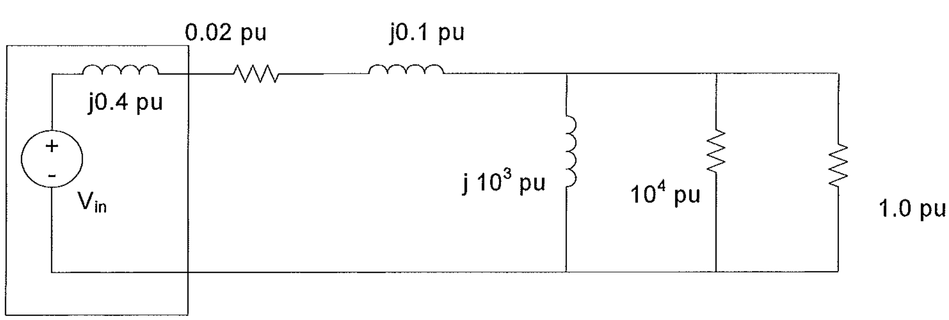
$$R_{Lpu} := \frac{7.2\cdot\Omega}{Z_{baseR}} = 1 \qquad X_p := \frac{11.5\cdot\Omega}{Z_{baseL}} = 0.1$$

$$R_{Cpu} := \frac{72\cdot k\Omega}{Z_{baseR}} = 1\times 10^4 \qquad R_P := \frac{2.3\cdot\Omega}{Z_{baseL}} = 0.02$$

$$X_{Mpu} := \frac{7.2\cdot k\Omega}{Z_{baseR}} = 1\times 10^3$$

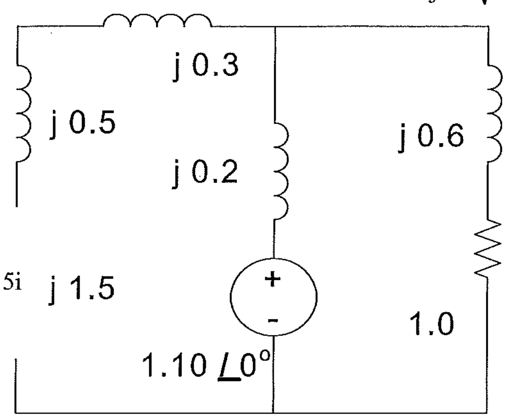
Convert the generator to per unit on the system base.

$$Z_{baseG} := \frac{(480\cdot V)^2}{2500\cdot V\cdot A} = 92.16\Omega \qquad X_G := \frac{0.50\cdot Z_{baseG}}{Z_{baseL}} = 0.4$$



2. (4 points) For the per unit circuit shown below, find the real power dissipated in the resistor.

$j := \sqrt{-1}$



A node method

$$\frac{V_X - 1.1}{j \cdot 0.2} + \frac{V_X}{j \cdot 2.3} + \frac{V_X}{1.0 + j \cdot 0.6} = 0$$

$$V_X := \frac{\dfrac{1.1}{j \cdot 0.2}}{\dfrac{1}{j \cdot 0.2} + \dfrac{1}{j \cdot 2.3} + \dfrac{1}{(1.0 + j \cdot 0.6)}} = 0.922 - 0.115i$$

Find the resistor current.

$$I_r := \frac{V_X}{1.0 + j \cdot 0.6} = 0.627 - 0.491i$$

Find the resistor power.

$$P_r := \left(\left|I_r\right|\right)^2 \cdot 1.0 = 0.634$$

Alternative method: use loop equations.

$$\begin{pmatrix} I_1 \\ I_r \end{pmatrix} := \begin{pmatrix} j \cdot 2.5 & -j \cdot 0.2 \\ -j \cdot 0.2 & 1.0 + j \cdot 0.8 \end{pmatrix}^{-1} \cdot \begin{pmatrix} 1.1 \\ -1.1 \end{pmatrix} = \begin{pmatrix} -0.05 - 0.401i \\ -0.627 + 0.491i \end{pmatrix}$$

$$P_r := \left(\left|I_r\right|\right)^2 \cdot 1.0 = 0.634$$