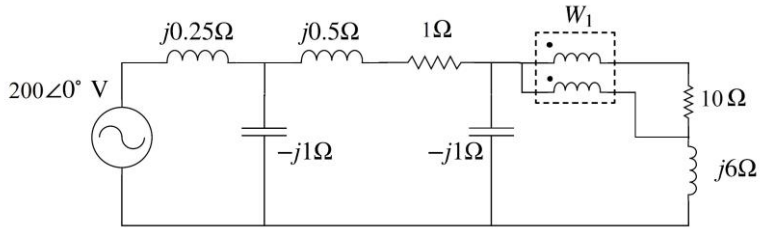
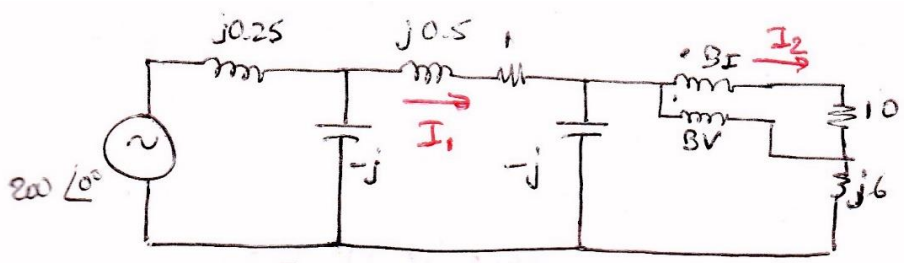
ESCUELA SUPERIOR POLITECNICA DEL LITORAL
FACULTAD DE INGENIERIA MECANICA Y CIENCIAS DE LA PRODUCCION
SEGUNDA EVALUACION DE ELECTROTECNIA DEL II TERMINO 2019
Prof.: MSC Mendieta **Paralelo:** **Fecha: 31 de enero 2020**

Nombre: SOLUCION FILA 1 Id.: Firma:

Primer Tema: 10 puntos

Calcule la lectura del vatímetro conectado en el circuito de la figura:





$$Z_{eq} = j0.25 + (-j) \,||\, [(j0.5+1) - j \,||\, (10+j6)]$$

$$Z_{eq} = j0.25 + (-j) \,||\, \left[(1+j0.5) + \frac{(1\angle -90^\circ)(10+j6)}{10+j5}\right]$$

$$Z_{eq} = j0.25 + (-j) \,||\, \left[(1+j0.5) + \frac{(1\angle -90^\circ)(11.66\angle 31^\circ)}{(11.2\angle 26.57^\circ)}\right]$$

$$Z_{eq} = j0.25 + (-j) \,||\, [(1+j0.5) + 1.04\angle -85.6^\circ]$$

$$Z_{eq} = j0.25 + (-j) \,||\, [1.08 - j0.537] = j0.25 + \frac{(1\angle -90^\circ)(1.206\angle -26.4^\circ)}{1.08 - j1.537}$$

$$Z_{eq} = j0.25 + \frac{1.206\angle -116.4^\circ}{1.879\angle -54.9^\circ} = j0.25 + 0.642\angle -62^\circ = 0.3 - j0.317$$

$$Z_{eq} = 0.436\angle -46.58^\circ$$

$$\Rightarrow I_T = \frac{200\angle 0^\circ}{0.436\angle -46.58^\circ} = 458.71\,A\angle 46.58^\circ$$

$$I_1 = \frac{-j}{-j + 1.08 - j0.537} I_T = \frac{1\angle -90^\circ (458.71\angle 46.58^\circ)}{1.878\angle -54.9^\circ} = 244.2\angle 11.48^\circ$$

$$I_2 = \frac{-j}{10+j5} I_1 = \frac{1\angle -90^\circ (244.2\angle 11.48^\circ)}{11.2\angle 26.57^\circ} = 21.8\angle -105.09^\circ\,A$$

$\Rightarrow$ el voltmetro lee la potencia en la resistencia de 10Ω.

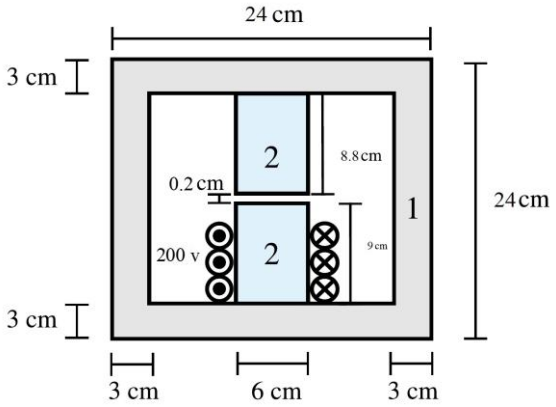
$$P_{10} = P_{wattmeter} = I_2^2 R = 21.8^2(10) = 4752.4\,W$$

Segundo Tema: 15 puntos

El circuito magnético de la figura está compuesto por dos materiales ferromagnéticos (1) y (2), además de un entrehierro. El primer material tiene una permeabilidad de $\mu_1 = 1500\ \mu_o$, y el segundo material de $\mu_2 = 2500\ \mu_o$. Todo el núcleo tiene una profundidad de 3 cm. Determine:

a) la inductancia de la bobina. (8 puntos)

b) la corriente dc necesaria para tener 0.8 T en el entrehierro. (7 puntos)



Solución: a) $L = ?$

$l_1 = 2(0.21\,m) = 0.42\,m$

$S_1 = (0.03)(0.03) = 9\times10^{-4}\,m^2$

$\mathcal{R}_1 = \frac{l_1}{\mu_1 S_1} = \frac{0.42}{(1500\times4\pi\times10^{-7})(9\times10^{-4})}$

$\mathcal{R}_1 = 247\,574.35\ H^{-1}$

entrehierro $l_g = 0.02\,m$

$S_g = (0.06)(0.03) = 1.8\times10^{-3}\,m^2$

$\mathcal{R}_g = \frac{l_g}{\mu_o S_g} = \frac{0.002}{(4\pi\times10^{-7})(1.8\times10^{-3})}$

$\mathcal{R}_g = 8\,841.94\,13\ H^{-1}$

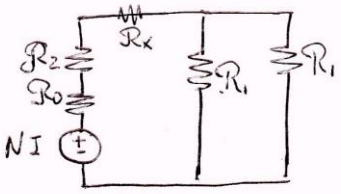
Material 2: $l_2 = 0.178\,m$ $\quad S_2 = (0.06)(0.03) = 1.8\times10^{-3}\,m^2$

$\mathcal{R}_2 = \frac{l_2}{\mu_2 S_2} = \frac{0.178}{2500(4\pi\times10^{-7})(1.8\times10^{-3})} = 31\,477.3\ H^{-1}$

* Consideran en la línea del material 2, los pequeños porcentajes del material 1: $l_x = 0.03\,m$ $\quad S_x = (0.06)(0.03) = 1.8\times10^{-3}\,m^2$

$\mathcal{R}_x = \frac{l_x}{\mu_1 S_x} = \frac{0.03}{1500(4\pi\times10^{-7})(1.8\times10^{-3})} = 8\,841.94\ H^{-1}$

Circuito magnético análogo



$\mathcal{R}_{eq} = \mathcal{R}_o + \mathcal{R}_2 + \mathcal{R}_x + \mathcal{R}_{1/2} = 1\,048\,300.5\ H^{-1}$

$\Rightarrow L = \frac{N^2}{\mathcal{R}_{eq}} = \frac{200^2}{1\,048\,300.5} = 38.16\,mH$

b) $I = ?$ $\quad \phi = BA = (0.8)(1.8\times10^{-3}\,m^2) = 1.44\times10^{-3}$

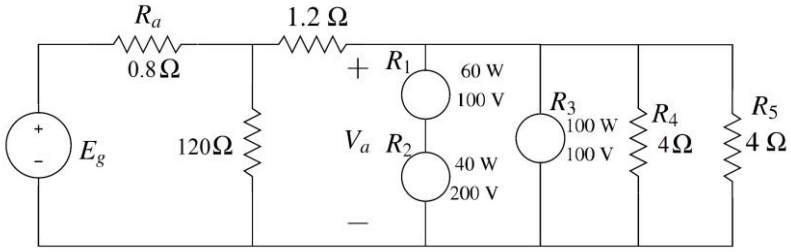
Como no hay dispersión, Tomamos el entrehierro

$NI = \phi\mathcal{R}_{eq} \Rightarrow I = \frac{\phi\mathcal{R}_{eq}}{N} = \frac{(1.44\times10^{-3})(1\,048\,300.5)}{(200)}$

$I = 7.55\ A$

Tercer tema: 10 puntos

Si la potencia entregada por R_4 es 1200 vatios, determine E_g.



Solución:

$P_4 = 1200 = I_4^2 R_4 \Rightarrow I_4 = \sqrt{1200/4} = 17.32\ A \Rightarrow V_4 = I_4 R_4$

$V_4 = 17.32(4) = 69.3\ V = V_5 = V_3 = V_a$

$\Rightarrow I_2 = 69.3/(R_1+R_2) = 69.3/(1166.7) = 0.0594\ A$ $\quad I_3 = 69.3/R_3 = 69.3/100 = 0.693$

$I_5 = 69.3/4 = 17.32\ A \Rightarrow I_1 = I_2 + I_3 + I_4 + I_5 = 0.0594 + 0.693 + 17.32 + 17.32 = 35.4\ A$

$I_F = \dfrac{I_1(1.2) + V_a}{120} = \dfrac{1.2(35.4) + 69.3}{120} = 0.9315\ A \Rightarrow I_T = I_1 + I_F = 35.4 + 0.9315$

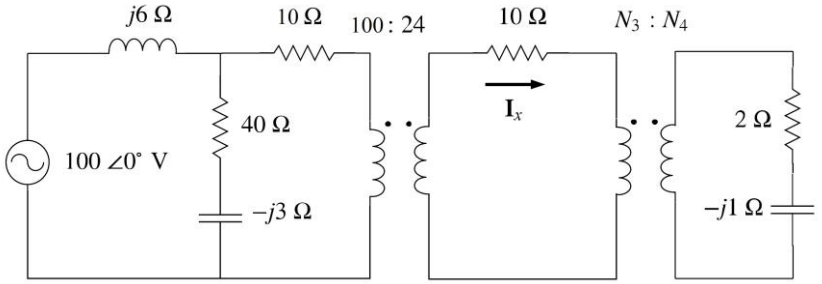
$\Rightarrow I_T = 36.33\ A \Rightarrow E_g = I_T(R_a) + 120\, I_F = 36.33(0.8) + 120(0.9315)$

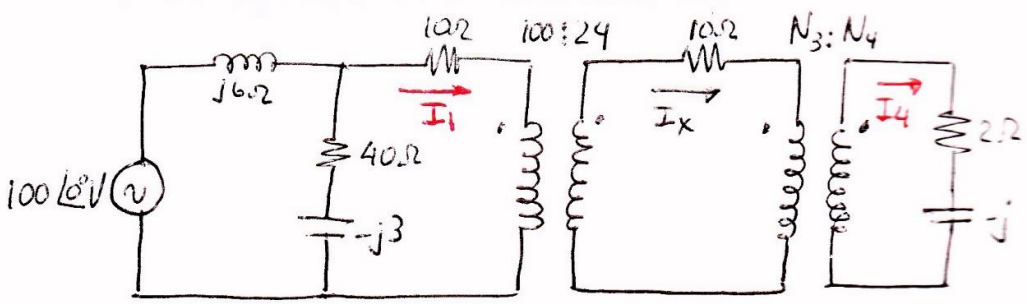
$E_g = 140.85\ V$

Cuarto tema: 15 puntos

a) Determine la potencia en vatios en la etapa de salida si N_3:N_4 = 2:5

b) Si N_3:N_4 = 5:8 determine I_x.





a) $N_3 : N_4 = 2:5 \Rightarrow Zent_1 = \frac{2-j}{(5/2)^2} = 0.32 - j0.16$

$\Rightarrow Zent_2 = \frac{10.32 - j0.16}{(24/100)^2} = 179.2 - j2.78$

b) $Zeq = 6\angle 90° + (40-j3) \,||\, [189.2 - j2.78] = 6\angle 90° + \frac{(40.1\angle -4.3°)(1892\angle -0.84°)}{229.2 - j5.78}$

$\Rightarrow Zeq = 6\angle 90° + \frac{7586.92\angle -5.14°}{229.27\angle -1.44°} = 6\angle 90° + 33.09\angle -3.6° = 33 + j3.715$

$Zeq = 33.21\angle 6.42°$

$\Rightarrow I_T = \frac{100\angle 0°}{Zeq} = \frac{100\angle 0°}{33.21\angle 6.42°} = 3.01\angle -6.42°\ A$

Por divisor de corriente $\Rightarrow I_1 = \frac{(40-j3)}{40-j3+10+Zent_2} I_T = \frac{(40.1\angle -4.3°)(3.01\angle -6.42°)}{229.2\angle -1.44°}$

$I_1 = 0.5265\angle -9.3°\ A$

$\Rightarrow I_x = \frac{100}{24} I_1 = 2.194\angle -9.3° \Rightarrow I_4 = \frac{2}{5} I_x = 0.8775\angle -9.3°$

$\Rightarrow$ La potencia en W corresponde solo a la resistencia

$\Rightarrow P_0 = I_4^2 R = 0.8775^2 (2) = 1.54\ W$

b) Si $N_3 : N_4 = 5 : 8 \Rightarrow Z_{ent1} = \frac{2-j}{(8/5)^2} = 0.78 - j0.4$

$$\Rightarrow Z_{ent2} = \frac{10.78 - j0.4}{(24/100)^2} = 187.15 - j6.94$$

$$\Rightarrow Z_{eq} = 6\angle 90^\circ + (40 - j3) \,||\, [10 + Z_{ent2}] = 6\angle 90^\circ + \frac{(40.1\angle -4.3^\circ)(197.15 - j6.94)}{237.15 - j9.94}$$

$$\Rightarrow Z_{eq} = 6\angle 90^\circ + \frac{(40.1\angle -4.3^\circ)(197.3\angle -2^\circ)}{(237.36\angle -2.4^\circ)} = 6\angle 90^\circ + 33.33\angle -3.9^\circ$$

$$Z_{eq} = 33.25 + j3.73 = 33.46\angle 6.4^\circ$$

$$\Rightarrow I_T = \frac{100\angle 0^\circ}{Z_{eq}} = \frac{100\angle 0^\circ}{33.46\angle 6.4^\circ} = 2.99\angle -6.4^\circ \text{ A}$$

Por divisor de corriente $\Rightarrow I_1 = \frac{(40 - j3)\ I_T}{40 - j3 + 10 + Z_{ent2}} = \frac{(40.1\angle -4.3^\circ)(2.99\angle -6.4^\circ)}{237.36\angle -2.4^\circ}$

$$\Rightarrow I_1 = 0.5051\angle -8.3^\circ \text{ A}$$

$$\Rightarrow I_x = \frac{100}{24} I_1 = 2.105\angle -8.3^\circ \text{ A}$$