Edwin Rodriguez
7-709-1004
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Tarea #3

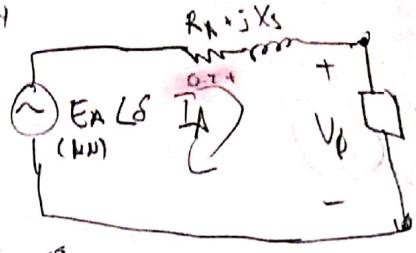
Desarrollo de problemas:

4-3) $I_F = 5A$ (Fijado) ; para problema (4-2)

$f = 60Hz$

"Y-Δ"

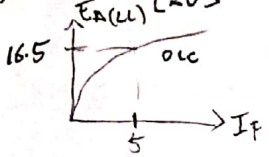
$Z_A = (0.2 + j2.5)\,\Omega$



Δ ⇝ carga conectada

V_ϕ

a) E_A = ? ⇝ carga conectada Δ $Z_{L_\Delta} = 24\angle 25°$



$I_F = 5A \Rightarrow E_{A(LL)} = 16.5kV$

$E_A = \frac{16.5k}{\sqrt{3}}$

$E_A = 9.53kV$ **

$Z_{L(\Delta)} \Rightarrow Z_{L(Y)} = (7.25 + 3.38j)\,\Omega = 8\angle 25°\,\Omega$

* Magnitud de I_A

$$I_A = \frac{E_A}{|Z_A + Z_L|} = \frac{9.53k}{|0.2 + j2.5 + 8\angle 25°|}$$

$I_A = 1004\,A$

Magnitud de V_ϕ

$V_\phi = I_A Z_L = (1004)(8)$

$V_\phi = 8032\,V$

$V_T = \sqrt{3}\,V_\phi = \sqrt{3}\,(8032)$

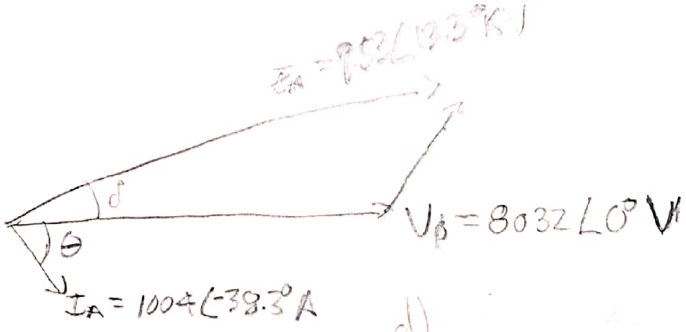
$V_T = 13.9\,kV$

b) $I_A = 1004\angle -25.8°\,A$

$V_\phi = 8032\angle 0°\,V$

$E_A = V_\phi \angle 0° + (R_A + X_S) I_A$

$E_A = (8032\angle 0°)(0.2 + j2.5)(1004\angle -25.8°)$ ⇒ $E_A = 9.53\angle 13.3°\,kV$ **



c) $\eta = \frac{P_{out}}{P_{in}} \times 100\%$

$P_{out} = 3 V_\phi I_A \cos\theta = 3(8032)(1004)(0.9)$

$P_{out} = 21.77\,MW$

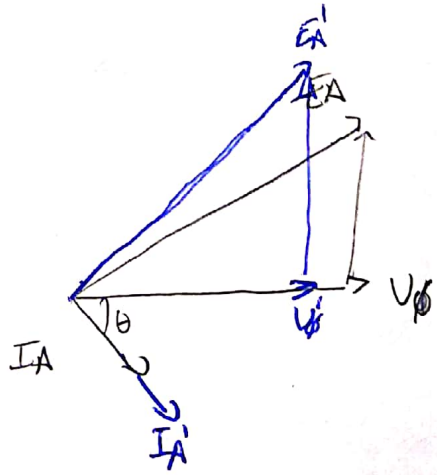
$P_{perd} = 3 I_A^2 R_A = 3(1004)^2(0.2) = 0.605\,MW$

$P_C = 1.5MW$; $P_{FWD} = 1.0MW$

$$\eta = \frac{21.77 \times 10^6}{21.77 \times 10^6 + 0.605 \times 10^6 + 1.5 \times 10^6 + 1 \times 10^6} \times 100$$

$\eta = 87.52\%$

d)



e) $Z_L \Rightarrow 4\angle 25°$

$I_A = \frac{9.53kV}{|0.2+j2.5+4\angle 25°|} =$

$V_\phi = I_A Z_L$

$V_\phi = (4\angle 25°)(\quad) =$

$V_T = \sqrt{3} V_\phi$

$V_T =$

f) Regresar V_t a su valor original
* Incrementar corriente de campo I_F

4.4) $I_F \Rightarrow$ Voltaje nominal → 13.8kV (terminal) @ plena carga → referencia prob 4.4 "Y"

pf = 0.9(-) ⇒ $\theta = 25.8°$

$I_L = I_A$

$S_{6(nominal)} = \sqrt{3} V_L I_L$

$I_L = I_A = \frac{50 \times 10^6}{\sqrt{3}(13.8k)}$

$I_A = 2091.84\ A \Rightarrow 2091.84\angle -25.8°\ A$

$V_\phi = \frac{13.8k}{\sqrt{3}} = 7.97V$

$V_\phi = 7.97k\angle 0°\ V$

$E_L S = 7.97k\angle 0° + (0.2+2.5j)(2091.84\angle -25.8°)$

$E_A L\delta = 11.56\angle 23.1°\ [kV]$

$P_{out} = 3 V_\phi I_A \cos\theta = 3(7.97k)(2091.84)(0.9)$

$P_{out} = 45.01\ MW$

$P_{elect} = 3 R_A I_A^2 = 3(0.2)(2091.84)^2$

$= 2.62\ MW$

$P_{core} = 1.5\ M$

$P_{F\&R} = 1\ MW$

$\eta = \frac{P_{out}}{P_{out} + P_{elect} + P_{core} + P_{F\&R}} \times 100\%$

$\eta = 89.8\% \approx 90\%$

* b) $V_\phi = 7.97kV\angle 0°$ → plena carga

$E_A = 11.56\angle 23.1$ ⇒ (a) No load $E_A = V_\phi \Rightarrow V_{\phi NL} = 11.56kV\angle 0°$

$VR(\%) = \frac{11.56k - 7.97k}{7.97k} \times 100 =$

* c) pf = 0.9(+)

$E_A L\delta = 7.97k\angle 0° + (0.2+2.5j)(2091.84\angle 25.8°)$

$E_A = 7.8\angle 38.85\ [kV]$

$VR(\%) = \frac{7.8 - 7.97}{7.97} \times 100 = -2.1\%$

* d) pf = 1 $\quad \cos^{-1}(1) = 0°$

$E_A = 7.97k\angle 0° + (0.2+2.5j)(2091.84\angle 0°)$

$E_A = 9.89\angle 31.74°\ [kV]$

* NCarga → $E_A = V_\phi$

$V_{\phi NL} = 9.89\angle 0°kV$

$VR(\%) = \frac{9.89k - 7.97k}{7.97k} \times 100$

$VR(\%) = 24\%$

4.5) $pf = 1$ — check valores del ptb. 4.2

a) $E_A \angle \delta = V_\phi \angle 0° + (R_A + X_S) I_A \angle \theta$

$= \left(\frac{13.8k}{\sqrt{3}}\right) \angle 0° + (0.2 + 2.5j)(2091.85 \angle 0°)$

$E_A = 9.88 \angle 31.95°$ kV

$\delta = 31.95°$

$S_{nom} = S_{G(nom)} = \sqrt{3} V_L I_L$

$I_L = \frac{50 \times 10^6}{\sqrt{3}(13.8k)} = 2091.85$ A

$I_L = I_A$ → conexión "Y"

$pf = 1 \rightarrow \theta = \cos^{-1}(1) = 0°$

$I_A = 2091.85 \angle 0°$ A

b) si límite de estabilidad → $\delta = 90°$

$R_A << X_S$

$P = \frac{3 V_\phi E_A}{X_S} \sin\delta$ ⇒ $P_{(\delta = 31.95)} = 49.99 \simeq 50$ kW

$P_{(\delta = 90°)} = 94.5$ kW

4.6) $E_{A_{(LL)}} = 14.4$ kV

$V_T = 12.8$ kV

$X_S = 4\,\Omega$

$R_A << X_S$

conectado "Y"

$f = 60$ Hz

$V_\phi = \frac{V_T}{\sqrt{3}} = 7.39$ kV

a) $\delta = 18°$

$E_A = \frac{14.4k}{\sqrt{3}}$

$E_A = 8.31$ kV

$P = \frac{3 V_\phi E_A}{X_S} \sin\delta$

$P = \frac{3(7.39k)(8.31k)}{4} \sin(18°)$ ⇒ $P = 14.23$ MW

b) $E_A \angle \delta = V_\phi \angle 0° + X_S (I_A \angle \theta)$

$I_A = \frac{E_A - V_\phi}{X_S} = \frac{(8.31 \times 10^3 \angle 18°) - 7.39 \times 10^3 \angle 0°}{4}$

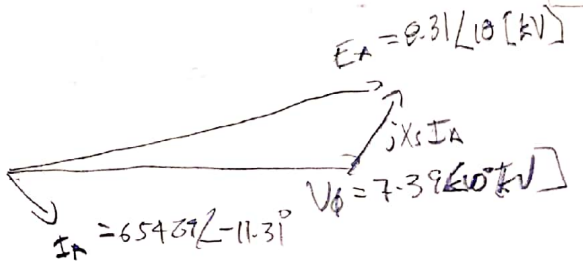
$I_A = 654.68 \angle 78.69$ A

-11.31

$pf = \cos(11.31)$

$pf = 0.98(-)$

c)



d) $P_{conversión} = \tau_{ind} \omega_m$

* no Pérdidas

$\tau_{app} = \tau_{ind} = \frac{P_{conv}}{\omega_m} \rightarrow \frac{14.23 MW}{376.99}$

$\tau_{app} = 37746$ N·m

$n_m = \frac{120}{\#p} \times f$

$= \frac{120}{2}(60) = 3600$ rpm

$\omega_m = n_m \cdot \frac{2\pi}{60}$

$= 376.99$ rad/s

4.7) $S_6 = 100\,MVA$, 14.4kV * Y conected

$f = 50Hz$ $X_S = 1.1\,pu$

$pf = 0.8(-)$ $R_A = 0.011\,pu$

$P = 2$

$V_\phi = \frac{14.4k}{\sqrt{3}} = 8314V$

a) $Z_{Base} = 3\frac{V_{\phi Base}}{S_{Base}} = \frac{3(8314)^2}{100X10^6}$

$Z_{Base} = 2.074\Omega$

$X_S = (1.1)(2.074\Omega)$

$X_S = 2.281\Omega$

$R_A = (0.011)(2.074\Omega)$

$R_A = 0.0228\,\Omega$

b) @ Nominal

$S_{nm} = S_{BN_{3\phi}} = 100MVA$ "Y" $\Rightarrow I_L = I_A$

$S_{3\phi} = \sqrt{3}\,V_{LL}\,I_L$

$\theta = \cos^{-1}(0.8) = 36.87°$

$pf = 0.8(-)$

$I_A = \frac{100X10^6}{\sqrt{3}(14.4X10^3)}$

$I_A = 4009A$ $I_A = 4009\angle -36.87°\,A$

$E_A = 8314\angle 0° + (0.0228 + j\,2.281)(4009\angle -36.87°)$

$E_A = 15660\angle 27.6°\,V \Rightarrow E_A = 15.66\angle 27.6\,[kV]$

c) Si $\rightarrow$ pasamos por alto perdidas del generador

$P_{out} = S_{3\phi}\,pf = (100M)(0.8)$

$P = \frac{3V_\phi E_A}{X_S}\sin\theta$

$P = 79.53\,MW$

$P_{out} = 80\,MW$

$P_{conv} = \tau_{ind}\,\omega_m$

$\tau_{app} = \tau_{ind} = \frac{P_{conv}}{\omega_m}$

$= \frac{80\,MW}{314.16}$

$= 254.6\,kN.m$

$n_m = \frac{120}{2}(50) = 3000\,r/min$

$\omega_m = n_m\frac{2\pi}{60} \Rightarrow 314.16\,rad/seg$