EE 330/330L Energy Systems (Spring 2012) Quiz #3

Name Key B

Instructions: Open book. Place answers in indicated spaces & show all work for credit.

A 210 KVA, 8000/230 V, 60 Hz single-phase transformer has a per-unit resistance of 1.2%, per-unit reactance of 6%, per-unit core loss resistance of 75, and per-unit magnetizing reactance of 28. Determine the turns ratio, base impedance, and approximate transformer circuit model referred to the secondary side. A load is supplied the rated voltage and load at a *pf* of 0.875 lagging. Determine the RMS phasor load current and load power. Use load voltage as phase reference.

$V_{base} = 230V$, (2-57) $Z_{base} \frac{V_{base}^2}{S_{base}} = \frac{230^2}{210\times10^3} = 0.251905\,\Omega$

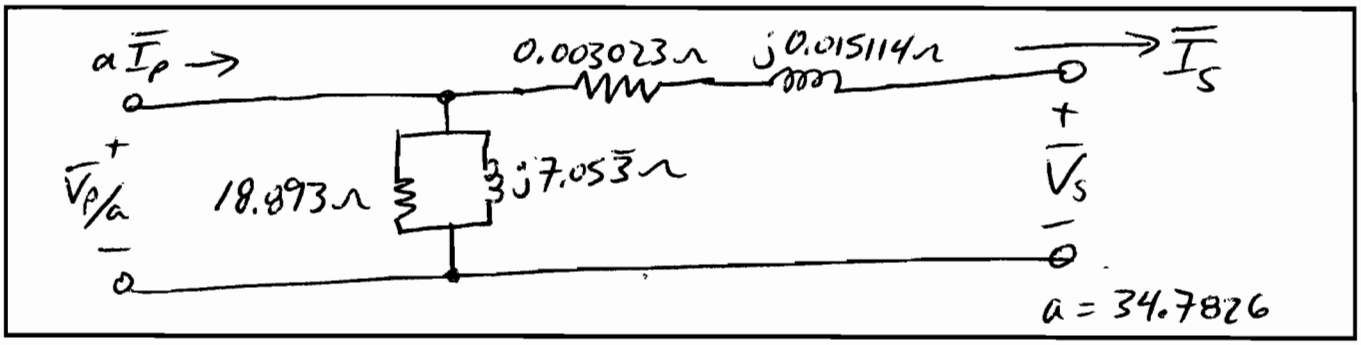
$R_{eq,s} = R_{eq,pu} Z_{base} = 0.012(0.2519) = 0.003023\,\Omega$

$X_{eq,s} = X_{eq,pu} Z_{base} = 0.06(0.2519) = 0.015114\,\Omega$

$R_{c,s} = R_{c,pu} Z_{base} = 75(0.2519) = 18.8929\,\Omega$

$X_{m,s} = X_{m,pu} Z_{base} = 28(0.2519) = 7.053\,\Omega$

Secondary side approximate transformer circuit model



$a = \frac{V_p}{V_s} = \frac{8000}{230} = 34.7826$

$\bar{I}_L = \frac{S_{rated}}{V_{rated}} = \frac{210\times10^3}{230} = 913.0435\,A_{rms}$

$\theta = \cos^{-1} pf = \cos^{-1}(0.875) = 28.955^\circ = \theta_V - \theta_I \Rightarrow \theta_I = -28.955^\circ$ ($\theta_V = 0^\circ$)

$P_L = S_L(pf) = V_L I_L \cos\theta = 210\times10^3(0.875)$

$= 183.75\times10^3\,W$

turns ratio = 34.78 base impedance = 0.2519Ω $\bar{I}_L = 913\angle -28.955^\circ A_{rms}$ $P_L = 183.75\,KW$