

Exam I Solution Spring 2001

1 (a) $I_{\text{phase}} = 6/\sqrt{3} = 3.46 \text{ A}$

(b) $|S| = \sqrt{3} \times 208 \times 6 = 2162 \text{ VA}$ $Q = \sqrt{2162^2 - 1700^2} = 1336 \text{ VARs}$

$1336 = 3 \times 208^2 \times 2\pi 60 C$ $C = 27 \mu\text{F}$

(c) $I_L = 1700/\sqrt{3} \times 208 = 4.7 \text{ A}$

2 $1250 = 4^2 R_{\text{eq}}$ $R_{\text{eq}} = 78 \Omega$ $Q_{\text{sc}} = \sqrt{(520 \times 4)^2 - 1250^2} = 1662 \text{ VARs}$

$1662 = 4^2 X_{\text{eq}}$ $X_{\text{eq}} = 104 \Omega$ $I_{\text{rated}} = \frac{50000}{12470} = 4 \text{ A}$

(a) $P_{\text{out}} = 240 \times 0.5 \times \frac{50k}{240} \times 0.9 = 22,500 \text{ W}$

$P_{\text{in}} = 22,500 + 620 + \left(\frac{4}{2}\right)^2 78 = 23,432$ $\eta = 96\%$

(b) $\% \text{Z} = \left(\sqrt{78^2 + 104^2} / (12,470/4) \right) \times 100 = 4.2\%$

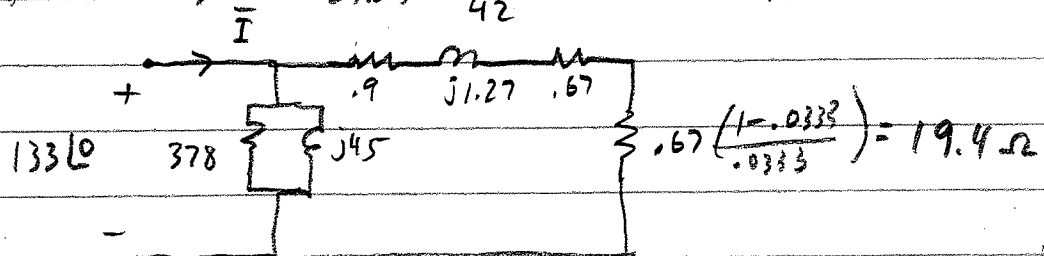
3 $S=0$ $V_{\text{Ln}} = \frac{230}{\sqrt{3}} = 133 \text{ V}$ $R_c = \frac{133^2}{140/3} = 378 \Omega$ $Q_{\text{NL}} = \sqrt{(399 \times 3)^2 - 140^2} = 1188 \text{ VARs}$

$X_m = \frac{133^2}{1188/3} = 45 \Omega$ $S=1$ $R_1 + R_2' = \frac{680/3}{12^2} = 1.57 \Omega$ $R_2' = 0.67 \Omega$

$Q_{\text{AR}} = \sqrt{(73 \times 2)^2 - 680^2} = 547 \text{ VARs}$ $X_1 + X_2' = \frac{547/3}{12^2} = 1.27 \Omega$

(a) $S=1$ full voltage $I_{\text{start}} = \frac{230}{42} \times 12 = 66 \text{ A}$

(b) $S=0.333$



$\bar{I} \approx \frac{133 \angle 0}{345} + \frac{133 \angle 0}{19.4} = -j2.9 + 6.9$ $|\bar{I}| = 7.5 \text{ A}$

(c) $T = \frac{3 \times 6.9^2 \times \frac{67}{0.93}}{126} = 23 \text{ Nm}$

(d) $T_{\text{max}} = \frac{3 \times 133^2}{2 \times 126 \times (1.9 + 1.81 + 1.27 \times 1/2)} = 86 \text{ Nm}$