ECE 333

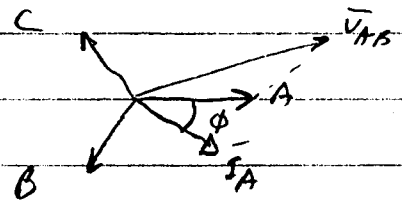
Final Exam Solution — Spring 94

#1 $P_{3\phi} = \sqrt{3} \times 206 \times 10 \cos\phi$

$Q_{3\phi} = \sqrt{3} \times 206 \times 10 \sin\phi$

$w.m._1 = 206 \times 10 \times \cos(30+\phi)$

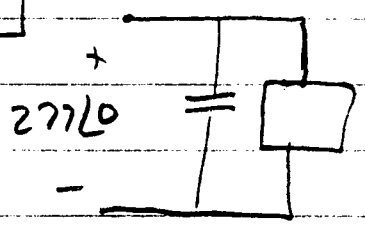
$= 800 \quad \phi = +37°$



$P_{3\phi} = 2,844\,w \qquad Q_{3\phi} = 2,147$ VARS

#2 $I_{\text{new rated}} = \frac{10,000}{240} = 41.67 \qquad \frac{1400}{41.67} = 33.6$ times rated $\qquad \%Z = 3\%$

#3



$2000\angle 37°$ VA

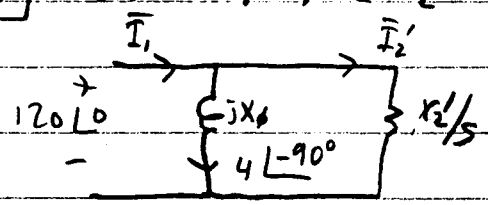
(a) $|\bar{I}| = \frac{2000}{277} = 7.2\,A$

(b) $Q_{3\phi} = 3611$ VARS

$3 \times 480^2 \times 2\pi 60 C = 3611 \qquad C = 13.9\,\mu F$

(c) $|I| = \frac{2000\cos 37}{277} \qquad |\bar{I}| = 5.77A$

#4 Neglect r_1 X_1 r_c X_2



$7\angle\theta = \underbrace{\frac{120\angle 0}{(r_2'/s)}}_{\text{pure real}} - j4 = I_R - j4$

$7^2 = I_R^2 + 4^2 \qquad I_R = 5.74A$

$P_{TO}{}_{\text{shaft}} \approx P_{TO}{}_{\text{rotor}} = 3 \times 120 \times 5.74 = 2068\,w \qquad HP \simeq 2.8$

$T_{TO}{}_{\text{shaft}} \simeq \frac{2068}{2\pi 60 \times \frac{1}{2}} = 11\,N.m.$

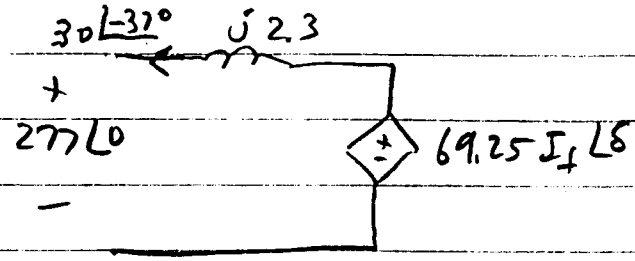
If you want, you could assume 85% efficient so,

$P_{TO}{}_{\text{shaft}} \simeq .85 \times 2068 = 1758$

$HP = 2.4$

#5 $K_f \omega \times 4 = \frac{480}{\sqrt{3}}$ $K_f \omega = 69.25$

$30 X_s = 69.25 \times 1$ $X_s = 2.3\ \Omega$

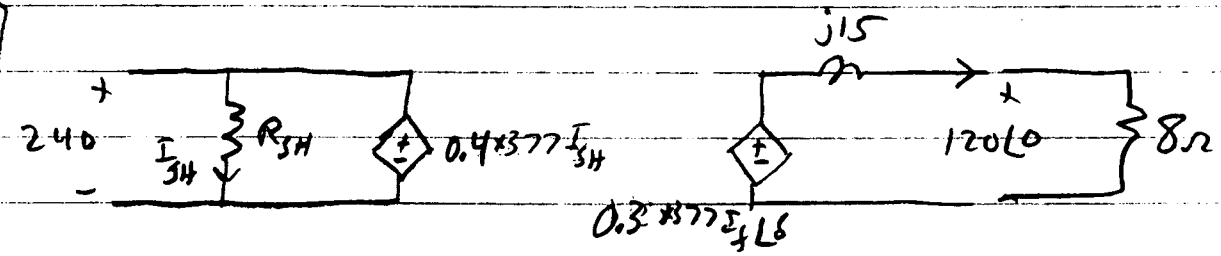


(a) $69.25 I_f \angle\delta = j2.3 \times 30\angle -37° + 277\angle 0$

$I_f \angle\delta = 0.6 + j0.8 + 4 = 4.6 + j0.8 = 4.67\angle 9.9°$

$I_f = 4.67\ A$ (b) lower because of saturation

#6



$0.3 \times 377\, I_f \angle\delta = \frac{120}{8}\angle 0 \times j15 + 120\angle 0$

$I_f \angle\delta = 1.989\angle 90° + 1.061$ $I_f = 2.25\ A$

$R_f = \frac{240}{2.25} = 106\ \Omega$

$240 = 0.4 \times 377\, I_{SH}$ $I_{SH} = 1.59\ A$ $R_{SH} = 151\ \Omega$