ECE 333

Final Exam Solution Spring 2002

#1 (a) $P^2 + Q^2 = (\sqrt{3} \times 208 \times 4)^2 = 2,073,600$

$P^2 + (Q-600)^2 = (\sqrt{3} \times 208 \times 3)^2 = 1,166,400$

OK $P^2 + Q^2 - 1200Q + 36,000 = 1,166,400$

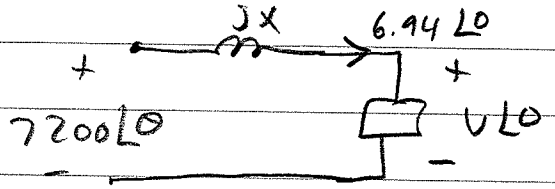
OR $2,073,600 - 1200Q + 360,000 = 1,166,400$ $\quad Q = 1056$ vars

(b) $P = 979$ w

(c) $979^2 + (1057-1200)^2 = (\sqrt{3} \times 208 \times I)^2$ $\quad I = 2.75$ A

#2 Try Short Circuit limit first. $\%_{min} Z = 5$

Now check voltage.



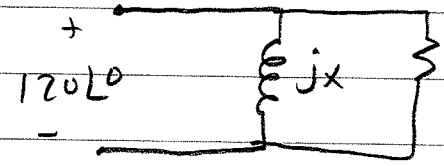
$I_{rated} = \frac{50k}{7200} = 6.94$

$7200\angle 0 = j.05 \times \left(\frac{7200^2}{50k}\right) \times 6.94\angle 0 + V\angle 0$

$= j360 + V \qquad 7200^2 = 360^2 + V^2 \qquad V = 7191$

Cannot go lower $\qquad$ OK

#3



$I_{NL} = 3$, so $X = 40\Omega$

(a) $s = \frac{1200-1080}{1200} = 0.1$

$f_r = 6$ Hz

(b) $\bar{I}_{FL} = 5\angle\theta = \frac{120}{j40} + \frac{120}{r_2'/s} = -j3 + \frac{120}{r_2'/s}$

so $\frac{120}{r_2'/0.1} = 4$ Amps $\qquad r_2' = 3\Omega$

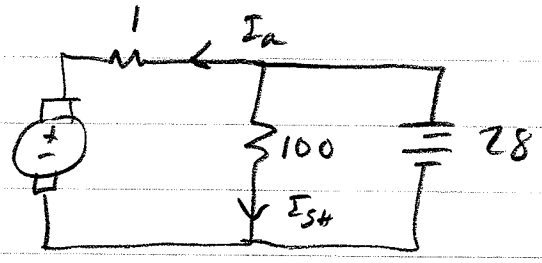
OR $P_{FL/\phi} = \frac{2 \times 746}{3} = 497\,w \simeq 4^2 \times \frac{r_2'}{.1}(1-.1)$ $\qquad r_2' = 3.5\Omega$

#4 $k_f \omega_s \times 3 = 120$ $\quad k_f \omega_s = 40\Omega$

$40 \times 1\angle 0 = jX_s \times 5\angle 0 + 120\angle 0$ $\quad 5X_s = 80$ $\quad \underline{X_s = 16\Omega}$

$P^* = P_{max} \sin 46° = \frac{3 \times 40 \times 1 \times 120}{16} \sin 46° = \underline{647\,w}$

#5



(a) No load $I_a = 0$

$1.2\omega \times \frac{28}{100} = 28$ $\quad \underline{\omega = 83.3\ r/s}$

(b) $1.2 \times 100 \times \frac{28}{R} = 28$ $\quad R = 120$ $\quad \underline{\text{add } 20\Omega}$

(c) $1.2\frac{28}{120} I_a = 3$ $\quad I_a = 10.7$ $\quad 28 = 1 \times 10.7 + 1.2\omega\frac{28}{120}$

$\underline{\omega = 62\ r/s}$

#6 (a) $k_f \times 1000 \times \frac{240}{200} = 240$ $\quad k_f = 0.2$

$0.2 \times 1200 \times \frac{240}{R} = 240$ $\quad \underline{R = 240\Omega}$

(b) Real power is transferred from the DC source into the grid

$P = 0.2 \times 1200 \times \frac{240}{275} \times \left(\frac{240 - 0.2 \times 1200 \times \frac{240}{275}}{4} \right) = \underline{1600w}$