ECE 333
Final Exam Solution Sp 98

#1

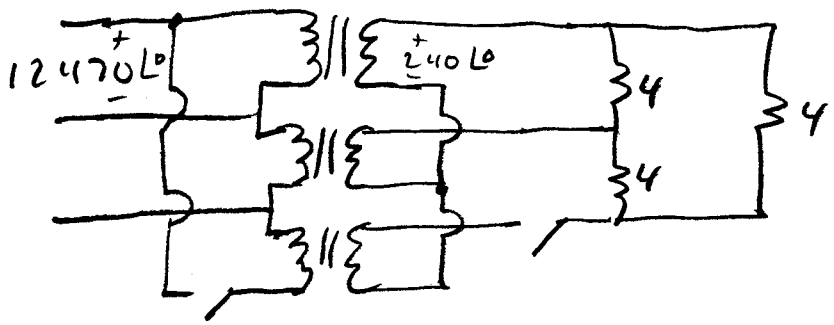
$$w_m = 208 \times 10 \times \cos(\angle \bar{V}_{AB} - \angle \bar{I}_c) = 2080 \cos(30° - (120° - \phi))$$

$$= 2080 \cos(\phi - 90°) = 1200$$

$$\cos(\phi - 90°) = 0.577 \qquad \phi - 90° = \pm 54.77°$$

$$\phi = 35.23° \qquad \boxed{pf = 0.82 \text{ lag}}$$

#2



(a) $\boxed{V_{l l_2} = 240\sqrt{3} = 416 \text{ v}}$

(b) $I_{l\text{-}l} = \frac{416}{4} = 104\text{A}$ $\quad VI_{3\phi} = 3 \times 104 \times 416 = 129{,}792$

$$\boxed{\%\text{loss} = \frac{130}{150} \times 100 = 86\ \%}$$

(c) $I_{l_2} = \sqrt{3} \times 104 = 180\text{A}$ $\quad I_{t_1} = 180 \times \frac{240}{12470} = 3.467\text{A}$

$$\boxed{I_{l_1} = \sqrt{3} \times 3.467 = 6\text{ A}}$$

(d) Switches open, $\boxed{V_{AB} = 416}$, $\boxed{V_{BC} = 208}$ $\boxed{V_{CA} = 208}$

#3 $VI_{3\phi} = \sqrt{3} \times 480 \times 8 = 6,651 \text{ VA}$

(a) $Q = \sqrt{6651^2 - 4000^2} = 5313 \text{ vars} = \frac{3 \times 480^2}{X_c}$

$X_c = 130\,\Omega = \frac{1}{2\pi 60 C}$ $\quad \boxed{C = 20\,\mu F}$

(b) $\boxed{I_{1_{min}} = \frac{4000}{\sqrt{3} \times 480} = 4.8 \text{ A}}$

#4

$10000 = P_{max} \sin(-\delta_0)$

$15000 = P_{max} \sin(-\delta_1)$ $\quad \delta_1 = \delta_0 - 20°$

$1.5 = \frac{\sin(20 - \delta_0)}{\sin(-\delta_0)}$

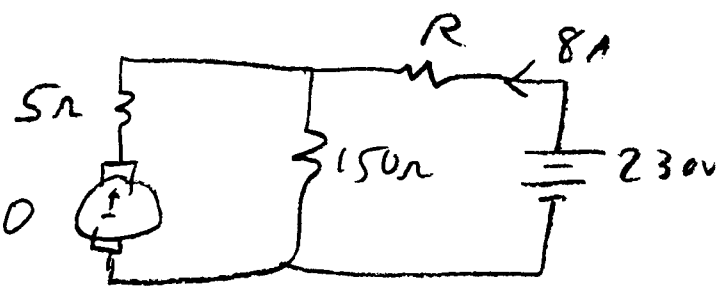
$-1.5 \sin\delta_0 = \sin 20 \cos\delta_0 - \cos 20 \sin\delta_0$

$-0.56 \sin\delta_0 = 0.342 \cos\delta_0$ $\quad \tan\delta_0 = -.6107$

$\boxed{\delta_0 = -31°}$

$\boxed{P_{max} = \frac{10000}{\sin 310} = 19,186 \text{ W}}$

#5



$5 // 150 = 4.84\,\Omega$

$230 = 8(R + 4.84)$

$\boxed{R = 23.91\,\Omega}$

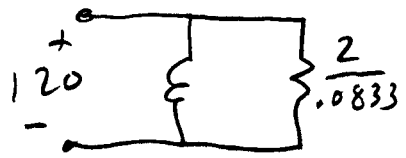
$I_f = \frac{230 - 8 \times 23.91}{150} = 0.26 \text{ A}$

$I_a = 7.74 \text{ A}$

$\boxed{T_{start} = 1.2 \times I_f \times I_a = 1.2 \times 0.26 \times 7.74 = 2.4 \text{ NM}}$

#6

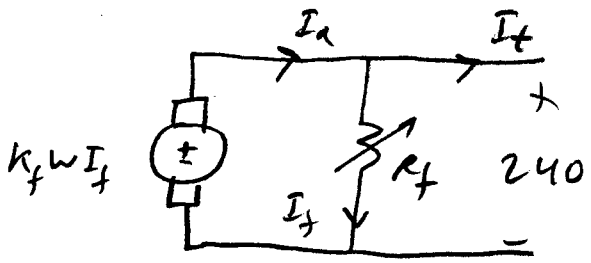
(a) $s = \frac{1200-1100}{1200} = .0833$



$$P_{IN} = 3 \times \frac{120^2}{2/.0833} = 1800\ W$$

(b) $P_{OUT} = (1-s) P_{IN} = .9167 \times 1800 = 1650\ W$

(c)



$k_f \times 1200 \times \frac{240}{200} = 240$ $\quad k_f = \frac{200}{1200} = 0.1667\ \Omega/RPm$

$0.1667 \times 1100 \times \frac{240}{R_f} = 240$ $\quad R_f = 183.3\ \Omega$ $\quad I_f = 1.3\ A$

$I_a = \frac{1650}{240} = 6.875$ $\quad I_f = 6.875 - 1.3 = 5.58\ A$

$P_{OUT} = 240 \times 5.58 = 1338\ W$