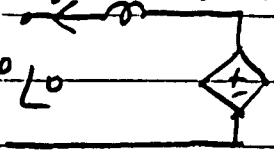
Exam II Solution Spring 1994

#1 OC $\frac{480}{V_3} = K_f w \times 5$ $K_f w = 55.43\ \Omega$ (Neglect R_a)

SC $55.43 \times 1 = 40 \times X_s$ $X_s = 1.386\ \Omega$



$\bar{I}_t = 40\angle -37°$

$55.43 I_f \angle\delta = 40\angle -37° \times 1.386\angle 90° + \frac{480}{V_3}\angle 0$

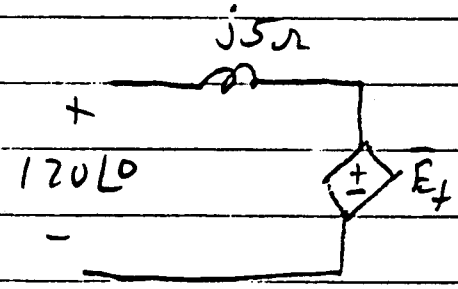
$= 55.44\angle 53° + 277\angle 0$

(a) $= 33.36 + j44.3 + 277 = 313.5\angle 8°$

$I_f = 5.66\ A$

(b) Lower because of saturation ($|\bar{E}_f|$ is less) and

#2



(a) $K_f w \times 2 = 120$

$K_f w = 60\ \Omega$

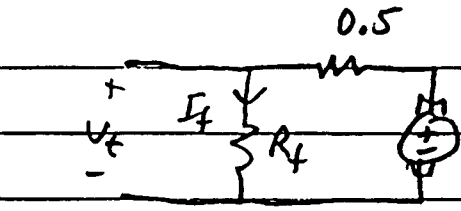
$60 \times 3\angle\delta = j5\,\bar{I} + 120\angle 0$

No load so $\delta = 0$ $|\bar{I}| = \left|\frac{180\angle 0 - 120\angle 0}{j5}\right|$

$|\bar{I}| = 12\ A$

(b) $P_{max} = \frac{3 \times 120 \times 60 \times 3}{5} = 12{,}960\ W$

#3



$I_f = 0$, $V_t = \lambda_R \omega$ $\quad \lambda_R = \frac{10}{1200 \frac{2\pi}{60}} = 0.0796$

$I_f = 1$, $V_t = 120V$ $\quad 10 + K_f^{SH} 1200 \frac{2\pi}{60} \times 1 = 0.5 \times 1 + 120$

$K_f^{SH} = 0.879$

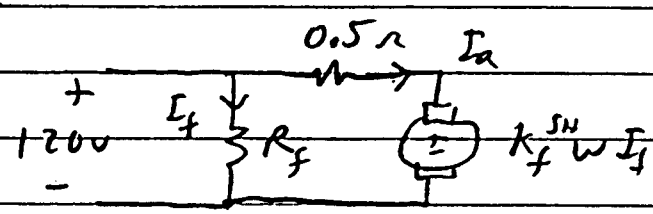
(a) $10 \frac{1180}{1200} + .879 \times 1180 \frac{2\pi}{60} \frac{120}{R} = 0.5\left(\frac{120}{30} + \frac{120}{R}\right) + 120$

$9{,}833 + \frac{13034}{R} = 2 + \frac{60}{R} + 120$

$9{,}833R + 13034 = 2R + 60 + 120R$ $\quad \underline{R = 115.7\Omega}$

(b) Lower because of saturation. The actual internal voltage will be less than the above.

#4



(a) For $I_f = 1$ $\quad \omega = 1400 \frac{2\pi}{60}$ $\quad I_a = 0$ $\quad K_f^{SH} \times 1400 \frac{2\pi}{60} \times 1 = 120$

$K_f^{SH} = \frac{120}{1400 \frac{2\pi}{60}} = 0.819$ $\quad$ For RPM = 1600, use

$120 = 0.819 \times 1600 \frac{2\pi}{60} I_f$

$I_f = 0.874$ $\quad \underline{R_f = 137\Omega}$

(b) $120 = 0.5 I_a + .819 \omega \times 1$

$\frac{.819 \omega \times 1 \times I_a}{\omega} = 10$ $\quad I_a = 12.2A$ $\quad \underline{\omega = 139.1 \text{ rad} \ (1328 \text{ RPM})}$

$\underline{I_f = 13.1A}$