I.D. #

Name ECE 333

Subject Sp 93

Course Section

Instructor SOLUTION

Date

Receiving or giving aid in a final examination is a cause for dismissal from the University.

(Begin Writing on this page)

#1

$$I_{\substack{LV \\ RATED}} = \frac{100{,}000}{120} = 833\,A$$

$$I_{sc} = \frac{1}{.07} \times 833 = 11{,}904\,A$$

#2

(a) $s=0$ $\quad |\bar{I}|_{NL} = \left|\frac{120}{j20}\right| = 6\,A$

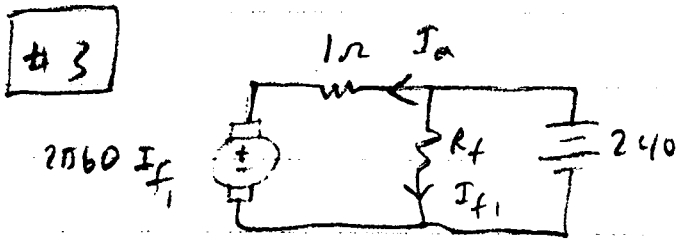
(b) $s=1$ $\quad |\bar{I}| = \left|\frac{120}{j20} + 120\right|$

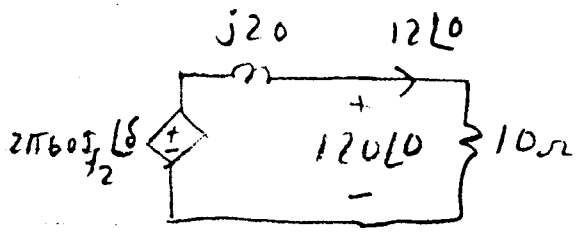
$$|\bar{I}|_{BR} = 120.15\,A$$

(c) $s = \frac{1800-1620}{1800} = .1$ $\quad |\bar{I}| = \left|\frac{120}{j20} + \frac{120}{10}\right| = 13.4\,A$

(d) $f_R = s f_s$ $\quad f_R = 6\,Hz$

#3





$P_{OUT}_{dc} = P_{IN}_{sync} = P_{OUT}_{sync}$ (no losses)

$P_{OUT}_{dc} = 2\pi 60\, J_{f_1} I_a$

$P_{IN}_{sync} = 3 \times Real(2\pi 60 I_{f_2}\angle\delta \times 12\angle -0)$

$2\pi 60\, I_{f_2}\angle\delta = 12\angle 0 \times j20 + 120\angle 0$

$I_{f_2}\angle\delta = \frac{120 + j240}{377} = 0.71\,\angle 63.4°$

$$R_{f_2} = \frac{240}{.71} = 338\,\Omega$$

#3 continued

$$240 = I_a + 2\pi 60 I_{f_1}$$

$$2\pi 60 I_{f_1}\left(240 - 2\pi 60 I_{f_1}\right) = 3 \times \text{Real}\left(268\angle 63.4^\circ \times 12\angle 0\right) = 4320$$

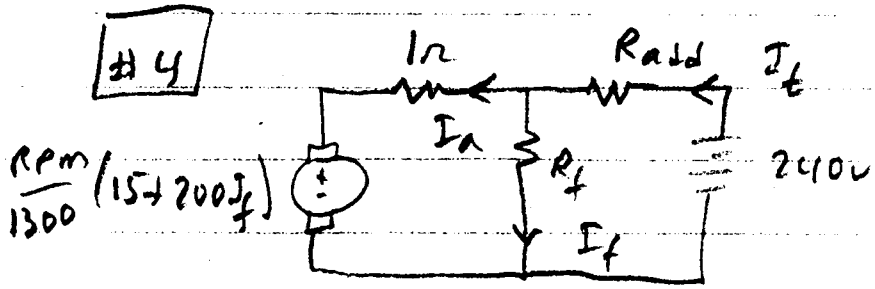
(note $P_{in\ sync} = 3 \times \frac{120^2}{10} = 4320$)

$$240 I_{f_1} - 2\pi 60 I_{f_1}^2 = 11.46 \qquad I_{f_1}^2 - .637 I_{f_1} + .0304 = 0$$

$$I_{f_1} = \frac{.637}{2} \pm .2665 = .585\ A \quad \text{or} \quad .052$$

$$\boxed{R_{f_1} = \frac{240}{.585} = 410\ \Omega}$$

#4



No load $R_{add} = 0$

$15 + 200 I_f = 240$

$I_f = 1.125 \quad R_f = 213.3\ \Omega$

Starting $Rpm = 0$ limit I_t

(a) $240 = R_{add} \times 10 + \frac{1 \times 213.3}{214} \times 10$

$$\boxed{R_{add} = 23\ \Omega}$$

(b) $240 = 23 I_t + 1 \times 0 + \frac{Rpm}{1300}(15 + 200 I_f)$ $\quad I_a = 0$ (no load)

So $I_f = I_t = \frac{240}{213.3 + 23}$

$I_f = 1.016A$

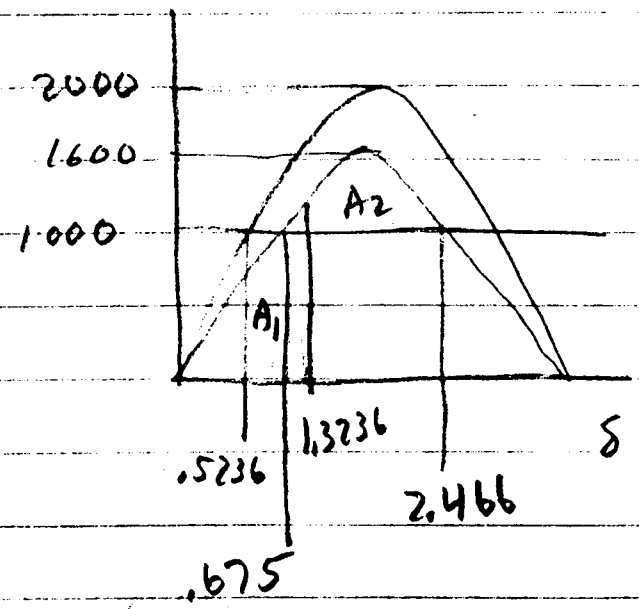
$240 = 23.37 + \frac{Rpm}{1300}(15 + 7032)$

$$\boxed{Rpm = 1291}$$

#5 $\frac{d\omega_t}{dt} = 1000$ $\omega_t = 1000t + 0$

$\frac{d\delta}{dt} = 1000t$ $\delta = 500t^2 + \pi/6$

$\delta(.04) = 1.3236$ rad $(75.8°)$



New equilibrium $= \sin^{-1}\frac{1}{1.6} = 38.7°$
$= 0.675$

$$A_1 = \int_{.5236}^{1.3236} (1000)\,d\delta = 800$$

$$A_2 = \int_{1.3236}^{2.466} (1600\sin\delta - 1000)\,d\delta = \left(-1600\cos\delta - 1000\delta \Big|_{1.3236}^{2.466} \right)$$

$$= (1249 - 2,466) - (-391.5 - 1323.6) = 498$$

NO IT WILL NOT BECAUSE $A_2 < A_1$

#6

$$\frac{di_a}{dt} = -5i_a - 12\omega + 1200 \qquad i_a(0) = 0$$

$$\frac{d\omega}{dt} = 12i_a - \omega^2 \qquad \omega(0) = 0$$

$$i_a(.001) = 0 + (-5\times0 - 12\times0 + 1200)\times.001 = 1.2\ A$$

$$\omega(.001) = 0 + (12\times0 - 0^2)\times.001 = 0\ r/s$$

$$i_a(.002) = 1.2 + (-5\times1.2 - 12\times0 + 1200)\times.001 = \boxed{2.394\ A}$$

$$\omega(.002) = 0 + (12\times1.2 - 0^2)\times.001 = \boxed{0.0144\ r/s}$$