

Exam II Solution

Spring 1996

$$1. \quad k_f \omega_s = \frac{120}{2} = 60 \text{ rad/s} \quad 60 \times 1 = 6 X_s, \quad X_s = 10 \Omega$$

$$60 I_f \angle \delta = j10(6 \angle 0) + 120 \angle 0 = 120 + j60 = 134.16 \angle 26^\circ \quad I_f = 2.236 \text{ A}$$

$$2. \quad \delta = 0, \text{ no load, } I_a = 0 \quad k_f \omega \times 10 = \frac{4160}{\sqrt{3}} = 2400 \quad k_f \omega = 240 \text{ rad/s}$$

$$I_f = 0 \quad I_a = 100 = \frac{4160/\sqrt{3}}{X_s} \quad X_s = 24 \Omega$$

$$\text{At unity pf, } I_a = \frac{100,000}{4160/\sqrt{3}} \angle 0 = 41.67 \angle 0^\circ$$

$$\frac{4160}{\sqrt{3}} \angle 0 = j24(41.67 \angle 0) + 240 I_f \angle \delta$$

$$240 I_f \angle \delta = 2400 - j1000 = 2600 \angle -22.6^\circ \quad I_f = 10.83 \text{ A}$$

$$3. \quad 10 + k_f \times 1200 \frac{2\pi}{60} \times 2 = 240 \text{ V} \quad k_f = 0.915 \quad R_f = \frac{240}{2} = 120 \Omega$$

$$10 \times \frac{1100}{1200} + 0.915 \times 1100 \frac{2\pi}{60} I_f = V_t = 120 I_f \quad 9.167 = 146 I_f \quad I_f = 0.628$$

$$V_t = 75 \text{ V}$$

$$4. \quad E_a = \omega R_a + k_f^{SH} \omega I_f \quad V_t = I_a R_a + \omega R_a + k_f^{SH} \omega \frac{V_t}{R_f}$$

$$(a) \quad \omega = \frac{V_t - I_a R_a}{\omega R_a + k_f^{SH} \frac{V_t}{R_f}} \quad V_t \gg I_a R_a \quad k_f^{SH} \frac{V_t}{R_f} \gg \omega R_a$$

$$\omega \approx R_f / k_f^{SH}$$

$$(b) \quad V_t \gg I_a R_a \quad k_f^{SH} I_f = \text{constant}$$

$$\omega = \frac{V_t}{k}$$