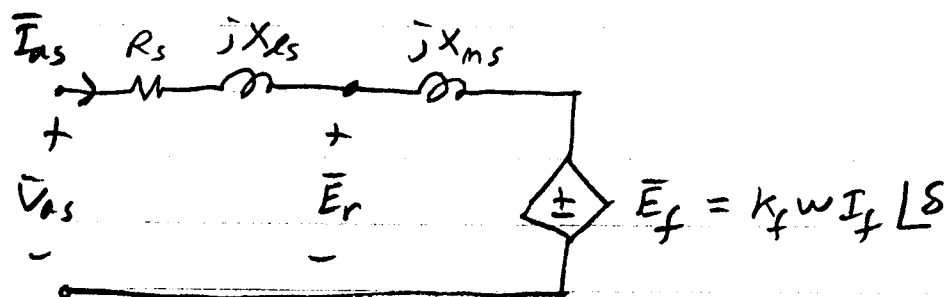


EXAM #2

SOLUTIONS

SPRING 1990

#1



$$\bar{E}_r = jX_{ms} \bar{I}_{as} + k_f w I_f L_s$$

$$\frac{j \bar{E}_r}{k_f w} = -\frac{X_{ms}}{k_f w} \bar{I}_{as} + j I_f L_s \quad \text{Define: } \bar{R} \triangleq \frac{j \bar{E}_r}{k_f w} \quad \bar{F} \triangleq j I_f L_s$$

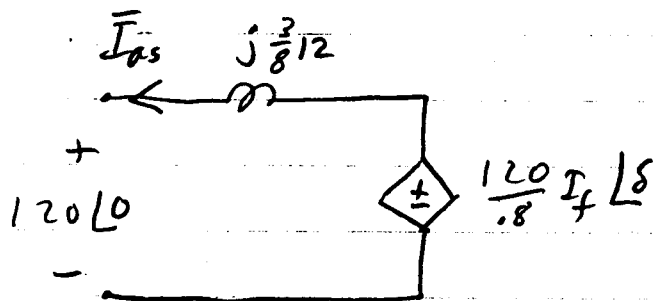
$$\bar{A} \triangleq -\frac{X_{ms}}{k_f w} \bar{I}_{as}$$

$$\underline{\underline{\bar{R} = \bar{F} + \bar{A}}}$$

#2

$$\text{OC TEST } k_f w = \frac{120}{.8}$$

$$\text{SC TEST } \frac{120}{.8} .3 = 10 X_s$$

Assume $\bar{V}_{as} = 0$ Then $\bar{I}_{as} = 0$ (unity PF)

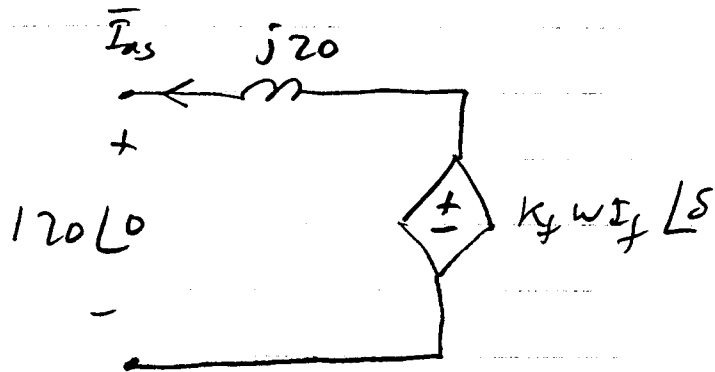
$$|\bar{I}_{as}| = \frac{\sqrt{120^2 + 0^2}}{120} = 10 \text{ A}$$

$$\frac{120}{.8} I_f L_s = 10 \angle 0 \frac{3}{8} 12 \angle 90 + 120 \angle 0 = 120 + j \frac{3}{8} 120$$

$$I_f L_s = .8 + j .3$$

$$I_f = \sqrt{.8^2 + .3^2} = \sqrt{.73} = \underline{\underline{.855 \text{ A}}}$$

#3



$$k_f \omega \times 1.0 \angle \delta = j20 \times 0 + 120 \text{ so } k_f \omega = 120$$

$$\bar{S}_{out} = 3 \times 120 \angle 0 \left(\frac{120 \angle \delta - 120 \angle 0}{j20} \right)^* = \frac{360 \times 120}{20} \angle -\delta + 90^\circ - \frac{360 \times 120}{20} \angle 90^\circ$$

$$P_{out} = \frac{360 \times 120}{20} \cos(-\delta + 90^\circ) = -\frac{360 \times 120}{20} \sin(-\delta) = 2160 \sin \delta$$

$$\underline{\underline{P_{max} = 2160 \text{ watts } 3\phi}}$$

#4

$$\frac{dx}{dt} = -3x^2 + 12 \quad x(0) = 1$$

$$x(.01) = x(0) + \left. \frac{dx}{dt} \right|_{t=0} .01$$

$$= 1 + (-3x^2(0) + 12) .01 = 1 + (-3 + 12) .01$$

$$\underline{\underline{x(.01) = 1.09}}$$