

Problem 3-13

$$V_1 = 110V$$

$$\frac{N_2}{N_1} = 2$$

$$f = 60 \text{ Hz}$$

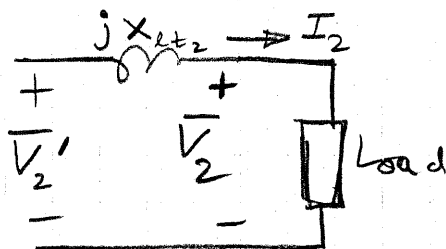
$$L_{lt2} = 5.15 \text{ mH}$$

$$X_{lt2} = \frac{5.15 \times (2\pi \times 60)}{1000} = 1.94 \Omega$$

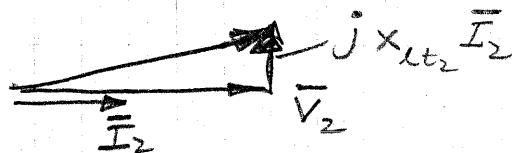
$$V_2' = 110 \times \frac{N_2}{N_1} = 220V$$

(V_2 at no-load)

$$\text{Full-load kVA} = 1$$



(a) at unity power factor



$$V_2 I_2 = 1000$$

$$V_2' = \left[V_2^2 + (X_{lt2} I_2)^2 \right]^{1/2}$$

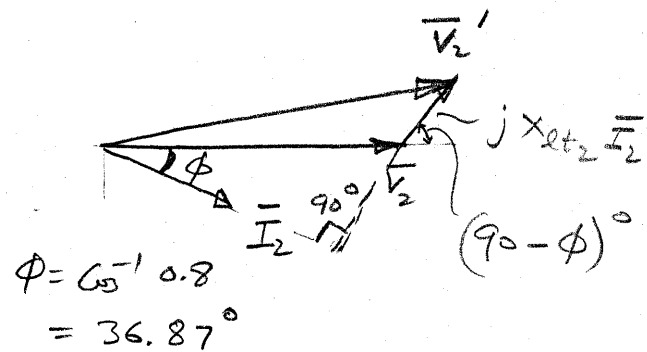
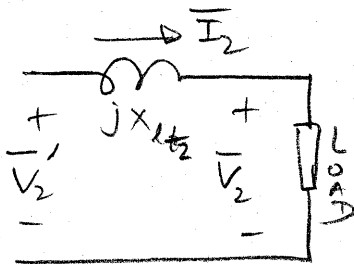
$$(V_2')^2 = V_2^2 + \left(X_{lt2} \frac{V_2}{1000} \right)^2$$

$$\propto V_2^2 \left[1 + \left(\frac{X_{lt2}}{1000} \right)^2 \right] = (V_2')^2$$

$$\therefore V_2 \approx V_2'$$

$$\% \text{ regulation} = 100 \times \frac{V_2' - V_2}{V_2'} \approx 0$$

(b) at 0.8 power factor (assumed to be lagging)



$$V_2 I_2 = 1000$$

$$\text{and } V_2' = V_2 + X_{lt2} I_2 \cos(90 - \phi)$$

$$\text{or, } V_2 \left(1 + X_{lt2} \frac{1}{1000} 0.6 \right) = 220$$

$$\therefore V_2 = 219.744 \text{ V}$$

$$\therefore \% \text{ Regulation} = \frac{220 - 219.744}{220} \times 100$$

$$= 0.116 \%$$