Problem 6-7

$P_d = 1\,kW$, $I_d = 10\,A$, $i_d \simeq I_d$

$V_s = 115\,V\ (+5\%, -10\%)$

Calculate L_s: $\omega = 2\pi \times 60 = 377\ rad/s$

Transformer $VA = 1500\ VA$

rated $V_{pri} = 120\,V$

rated $I_{pri} = 1500/120 = 12.5\,A$

$Z_{base} = V_{pri}/I_{pri}$ (rated) $= 9.6\,\Omega$

$\omega L_s = (8\%)\ Z_{base}$

or $L_s = 0.08 \times 9.6/377$

$\simeq 2\,mH$

α cannot go below 0°. Therefore, to calculate the minimum transformer turns ratio a (where $a = \frac{V_{pri}}{V_{sec}}$), in Eq. 6-26

$$V_d = \frac{0.9}{a} V_s \cos\alpha - \frac{2}{\pi}\omega(L_s) I_d$$

In a rigorous calculation, this should be $\left(\frac{L_s}{a^2}\right)$

Substitute $V_d = 100\,V$, $\alpha = 0^\circ$ and $V_s^{min} = 115\,V(-10\%)$

$= 103.5\,V$

$\therefore$ From the above Eq: $a_{minimum} \simeq 0.89$

With $a_{minimum}$ and $V_s = 115\,V(+5\%) = 120.75\,V$,

the above Eq yields $\alpha = 31^\circ$ for $V_d = 100\,V$.