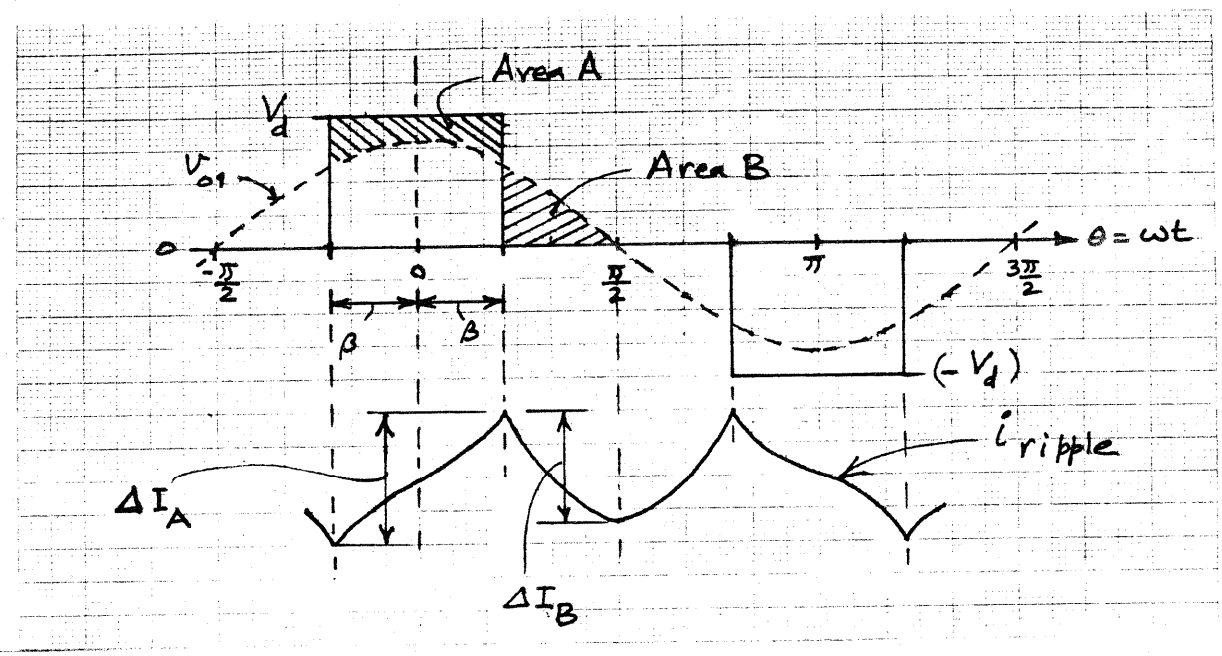
Problem 8-4

Voltage cancellation, $V_d = 389V$ (problem 8-3), $L = 100$ mH, $V_{01} = 220V$, 47 Hz
Find angle β.

From Eq. 8-37

$$\hat{V}_{01} = \frac{4}{\pi} V_d \sin\beta$$



$$\therefore \qquad \beta = \sin^{-1}\left(\frac{\sqrt{2} \times 220\ \pi}{4 \times 389}\right) = 0.679 \text{ rad}$$

In the figure as shown

$$\Delta I_A = \frac{\text{Area A}}{L}$$

$$\Delta I_B = \frac{\text{Area B}}{L}$$

Find ΔI_A and ΔI_B:

$$\Delta I_A = \frac{1}{\omega L} \int_{-\beta}^{\beta} (V_d - \sqrt{2}\, V_{01} \cos\theta)\, d\theta = \frac{1}{\omega L}(2\beta V_d - 2\sqrt{2}\, V_{01} \sin\beta) = 4.66\text{A}$$

$$\Delta I_B = \frac{1}{\omega L} \int_{\beta}^{\pi/2} \sqrt{2}\, V_{01} \cos\theta \cdot d\theta = \frac{1}{\omega L} \sqrt{2}\ V_{01} (1 - \sin\beta) = 3.92\text{A}$$

$\Delta I_A > \Delta I_B$

$\therefore$ peak ripple current = $\frac{\Delta I_A}{2}$ = 2.33 A peak.