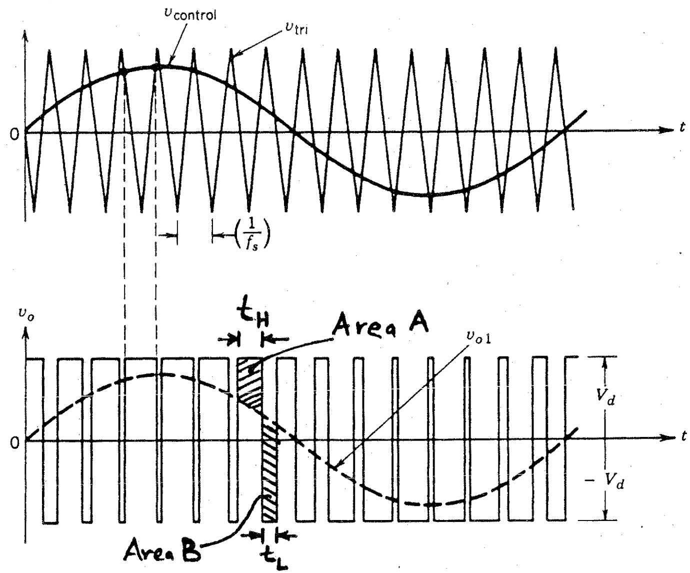
Problem 8-3

PWM-VSI Full bridge Inverter: $m_f = 21$, $m_a = 0.8$, $V_{01} = 220V$, 47 Hz

$$V_d = \sqrt{2} \cdot 220 \cdot \frac{1}{0.8} = 389V$$

Find Areas A and B:



Since m_f is large, approximate $v_{control}(t)$ as constant during a switching cycle.

Then, $$A(t) = t_H \cdot (V_d - m_a V_d \cdot \sin \omega t)$$ [Note: $\hat{V}_o = m_a V_d$]

$$B(t) = t_L \cdot (V_d + m_a V_d \cdot \sin \omega t)$$

$$t_L = \frac{T_s}{2}\left(1 - \frac{\hat{V}_c \sin\omega t}{\hat{V}_{tri}}\right) = \frac{T_s}{2}(1 - m_a \sin \omega t)$$

[where $\hat{V}_c$ = peak of control voltage $v_{control}$]

$$t_H = T_s - t_L = \frac{T_s}{2}(1 + m_a \cdot \sin \omega t)$$

So,

$$\text{Area A} = \frac{T_s}{2}(1 + m_a \sin \omega t)[V_d(1 - m_a \sin \omega t)] = \frac{V_d}{2f_s}(1 - m_a^2 \sin^2\omega t)$$

$$\text{Area B} = \frac{T_s}{2}(1 - m_a \sin \omega t)[V_d(1 + m_a \sin \omega t)] = \frac{V_d}{2f_s}(1 - m_a^2 \sin^2\omega t)$$

$\therefore$ Area A = Area B (as they should be)

Notice both area A and area B are greatest at $t = 0$. Therefore I_{ripple} will be greatest at $t = 0$. Using Eq. 8-42,

maximum $$I_{ripple_{p-p}} = \frac{A(t=0)}{L} = \frac{V_d}{2f_s L} = \frac{389V}{2(21 \cdot 47)(100 \text{ mH})} = 1.97A$$

Note: This is peak to peak ripple.

$$\therefore \text{ Peak ripple current} = \frac{1.97}{2} = 0.98A$$