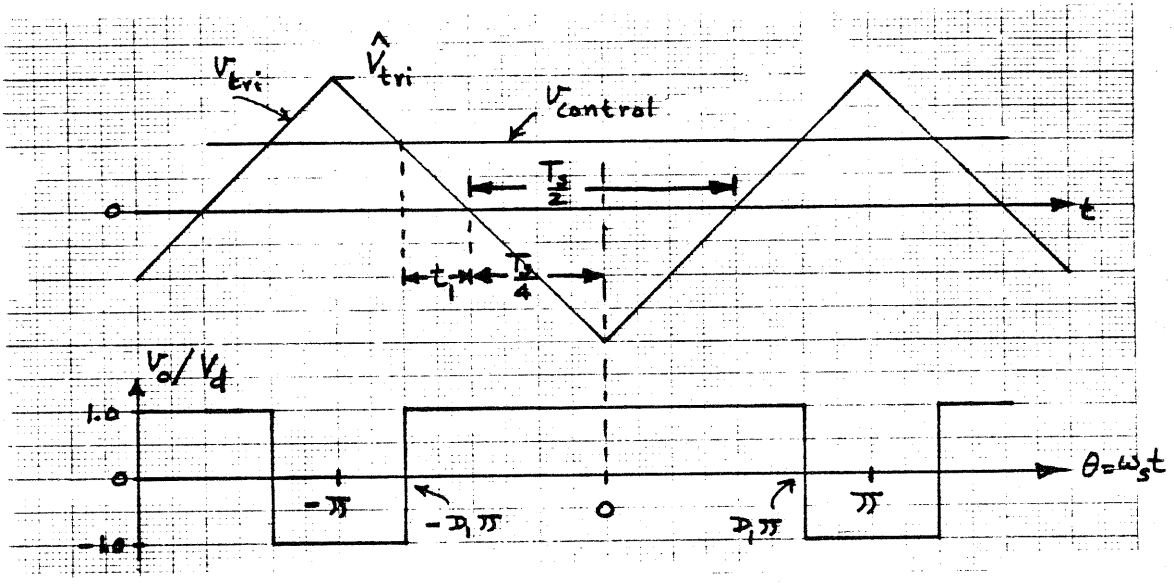
Problem 7-18



Even function: f(t) = -f(t)

From Eqs. 7-71 and 7-72

$t_1 + \frac{T_s}{4} = \frac{D_1 T_s}{2}$ $\therefore$ $\omega_s(t_1 + \frac{T_s}{4}) = \pi D_1$

For an even function:

$$f(t) = \frac{1}{2} a_o + \sum_{n=1}^{\infty} a_n \cos n\omega_s t$$

$$a_n = \frac{4}{T_s} \int_0^{T_s/2} f(t) \cdot \cos(n\omega_s t) \cdot dt$$

$$= \frac{4}{\omega_s T_s} \int_0^{\omega T_s/2} f(\omega_s t) \cdot \cos(n\omega_s t) \cdot d(\omega_s t) = \frac{2}{\pi} \int_0^{\pi} f(\theta) \cdot \cos(n\theta) \cdot d\theta$$

where $\omega_s T_s = 2\pi$ and $\omega_s t = \theta$. D_1 is the duty-ratio as defined in Eq. **7-72.**

$$\therefore a_o = \frac{2}{\pi}\left[\int_0^{D_1\pi} 1 \cdot d\theta + \int_{D_1\pi}^{\pi} (-1) \cdot d\theta\right] = \frac{2}{\pi}[D_1\pi - \pi + D_1\pi] = 2[2D_1 - 1]$$

From Eq. **7-72,** $D_1 = 0.75$

$$\therefore \frac{V_o}{V_d} = \frac{1}{2} a_o = 0.5$$

$$a_n = \frac{2}{\pi}\left[\int_0^{D_1\pi} 1 \cdot \cos(n\theta) \cdot d\theta + \int_{D_1\pi}^{\pi} (-1) \cdot \cos(n\theta) \cdot d\theta\right]$$

$$= \frac{2}{n\pi}[\sin(D_1 \cdot n\pi) - \sin(n\pi) + \sin(D_1 n\pi)] = \frac{2}{n\pi}[2 \cdot \sin(D_1 n\pi)]$$

$$= \frac{4}{n\pi} \sin(D_1 n\pi)$$

$$\therefore \frac{\hat{V}_{o,n}}{V_d} = \frac{4}{n\pi} \sin D_1 n\pi \qquad n = 1,2,3,...$$

(n represents the nth multiple of the switching frequency f_s and $\hat{V}_{o,n}$ is the peak amplitude)

n	$\frac{\hat{V}_{o,n}}{V_d}$ ($D_1 = 0.75$)
1	0.9
2	0.64
3	0.3
4	0
5	0.18
6	0.212

Note: We are asked to assume that $i_o(t) \simeq I_o$. Therefore, $[i_d(t)/I_o]$ waveform will be identical to the $[v_o(t)/V_d]$ waveform shown earlier.

Also, the Fourier components of $[i_d(t)/I_o]$ will be identical to those shown in the Table on the left.