

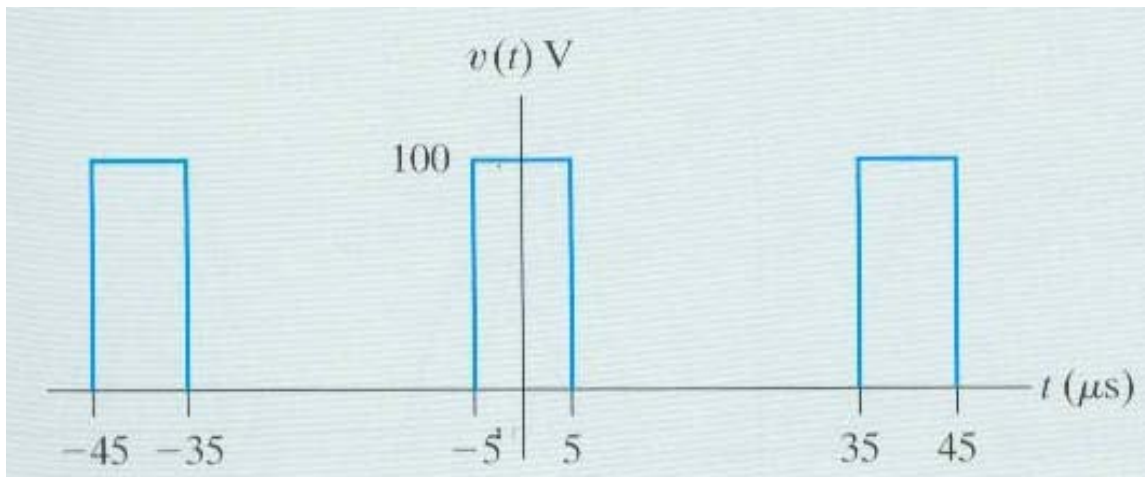
Homework Assignment #6

Reading Assignment:

Chapter 16 in Electric Circuits, 8th Edition by Nilsson

Problem Assignment:

- 1) Work the following Ch. 16 problems: 1, 2 (a and c only), 10, 14(a-d only), 18, 27, 29, 33
- 2) Graph the Fourier series for the waveform of below using Excel, MathCAD, or MatLab. Note that the Fourier series has already been provided below. In particular, form 5 graphs:
 - DC only
 - DC + 1st harmonic
 - DC + 1st through 2nd harmonics
 - DC + 1st through 3rd harmonics
 - DC + 1st through 4th harmonics



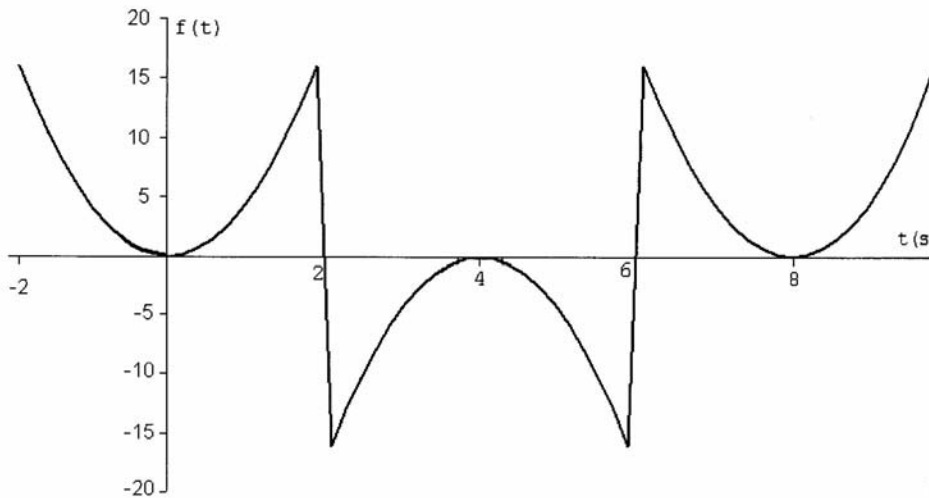
$$v(t) = 25 + \frac{200}{\pi} \sum_{n=1}^{\infty} \left[\frac{1}{n} \sin\left(\frac{n\pi}{4}\right) \cos(n\omega_0 t) \right] \text{ V}$$

Selected Answers:

- 16.14) a) See sketch below
 b) Even since $f(t) = f(-t)$
 c) Yes, since $f(t) = -f(T/2 - t)$ in the interval $0 < t < 4$
 d) $a_v = 0$, $b_k = 0$ for all k (function is even), $a_k = 0$ for even k (half-wave symmetry).

$$v(t) = 64 \sum_{n=1,3,5,\dots}^{\infty} \left[\frac{n^2 \pi^2 - 8}{\pi^3 n^3} \right] \sin\left(\frac{n \cdot \pi}{2}\right) \cos(n\omega_0 t)$$

16.14a) The periodic waveform described is shown below.



16.29) Partial solution

$$\omega_o = \frac{2\pi}{T} = 240\pi \text{ rad/s}$$

$$\begin{aligned} f(t) &= \frac{2(54\pi)}{\pi} - \frac{4(54\pi)}{\pi} \sum_{n=1}^{\infty} \frac{\cos n(240\pi)t}{4n^2 - 1} \\ &= 108 - 216 \sum_{n=1}^{\infty} \frac{\cos n(240\pi)t}{4n^2 - 1} \end{aligned}$$

$$H(s) = \frac{4 \times 10^4}{s^2 + 80s + 4 \times 10^4}$$

$$\begin{aligned} H_1(j240\pi) &= \frac{4 \times 10^4}{4 \times 10^4 - 5.76\pi^2 \times 10^4 + j1.92 \times 10^4\pi} \\ &= 0.0752 / -173.49^\circ \end{aligned}$$

$$\begin{aligned} H_2(j480\pi) &= \frac{4 \times 10^4}{4 \times 10^4 - 23.04\pi^2 \times 10^4 + j3.84 \times 10^4\pi} \\ &= 0.0179 / -176.91^\circ \end{aligned}$$

$$\mathbf{V}_{o1} = 72 / 180^\circ H_1 = 5.41 / 6.51^\circ \text{ V}$$

$$\mathbf{V}_{o2} = 14.4 / 180^\circ H_2 = 0.2575 / 3.09^\circ \text{ V}$$

$$\begin{aligned} v_o &= 108 + 5.41 \cos(240\pi t + 6.51^\circ) + 0.2575 \cos(480\pi t + 3.09^\circ) \\ &\quad - 0.0486 \cos(720\pi t + 2.04^\circ) + \dots \text{ V} \end{aligned}$$