Serial # 0

-1 points for not writing your serial #

King Fahd University of Petroleum & Minerals
Electrical Engineering Department
EE207: Signals & Systems (121)
Quiz 3: Fourier Series
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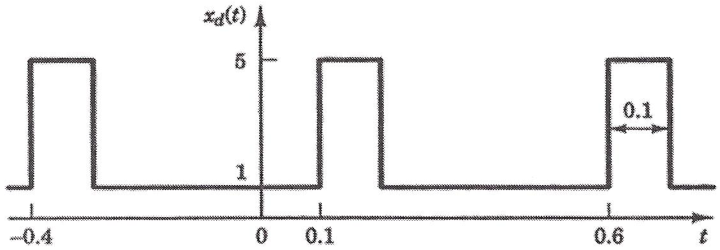
Name: KEY ver. B

For the shown periodic signal, $x_d(t)$



a) Find the fundamental period T_0. $T_0 =$ 0.5 **(1 point)**

b) Find the average value, C_0. **(3 points)**

$$C_0 = \frac{1}{T_0}\int_{T_0} x_d(t)\,dt = \frac{1}{0.5}\left[\int_{-0.4}^{-0.3} 5\,dt + \int_{-0.3}^{0.1} dt\right]$$

$$= 2\,[0.5 + 0.4] = 2\,[0.9] = 1.8$$

c) Utilize the attached table (Fourier Series for Rectangular wave) to find $|C_k|$ for $x_d(t)$ **(3 point)**

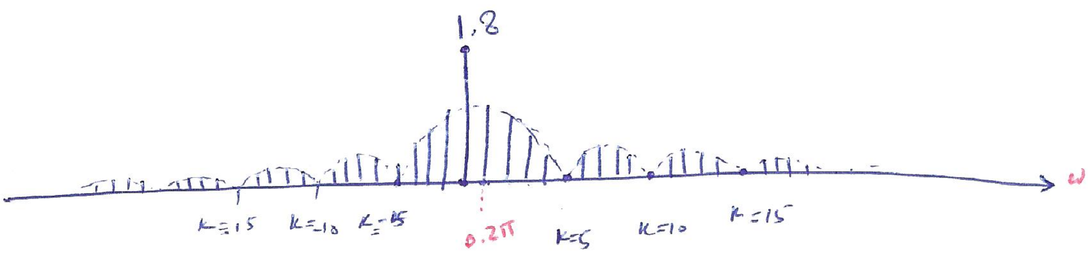
Comparing the two, time delay will only affect the phase & shifts up by 1 unit.

$\frac{T}{2} = 0.05$, $T_0 = 0.5$, $T = 0.1$, $X_0 = 4$, $\omega_0 = \frac{2\pi}{T_0} = 4\pi$

$$C_k = \frac{T X_0}{T_0}\,\text{sinc}\,\frac{T k \omega_0}{2} = \frac{0.1(4)}{0.5}\,\text{sinc}\,\frac{0.1\,k(4\pi)}{2} = 0.8\,\text{sinc}(0.2k\pi) = C_k$$

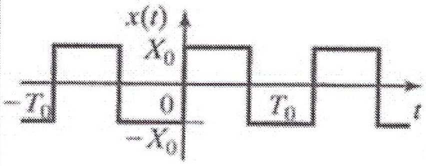
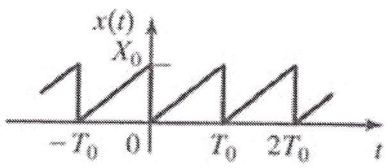
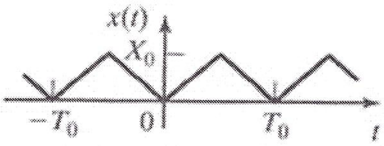
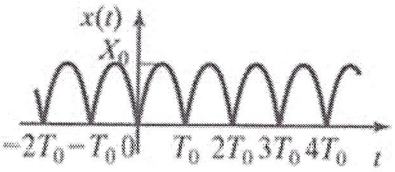
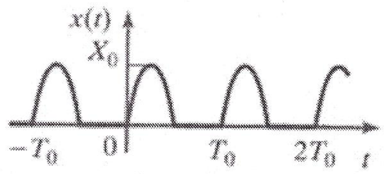
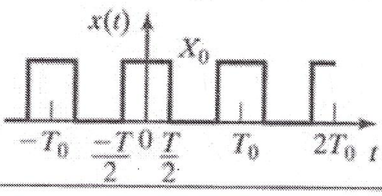
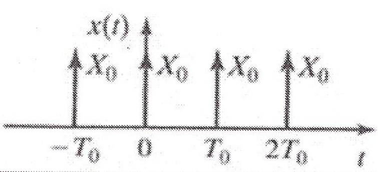
(+1) shift $C_k = 0.8\,\text{sinc}(0.2k\pi)$, $k \neq 0$ $C_0 = 0.8 + 1$

d) Sketch the double sided magnitude spectrum. **(3 points)**



Education is what survives when what has been learned has been forgotten.
Good luck,

Fourier Series for Common Signals

Name	Waveform	C_0	$C_k, k \neq 0$	Comments
1. Square wave		0	$-j\,\frac{2X_0}{\pi k}$	$C_k = 0$, k even
2. Sawtooth		$\frac{X_0}{2}$	$j\frac{X_0}{2\pi k}$	
3. Triangular wave		$\frac{X_0}{2}$	$\frac{-2X_0}{(\pi k)^2}$	$C_k = 0$, k even
4. Full-wave rectified		$\frac{2X_0}{\pi}$	$\frac{-2X_0}{\pi(4k^2-1)}$	
5. Half-wave rectified		$\frac{X_0}{\pi}$	$\frac{-X_0}{\pi(k^2-1)}$	$C_k = 0$, k odd, except $C_1 = -j\frac{X_0}{4}$ and $C_{-1} = j\frac{X_0}{4}$
6. Rectangular wave		$\frac{TX_0}{T_0}$	$\frac{TX_0}{T_0}\,\text{sinc}\,\frac{Tk\omega_0}{2}$	$\frac{Tk\omega_0}{2} = \frac{\pi Tk}{T_0}$
7. Impulse train		$\frac{X_0}{T_0}$	$\frac{X_0}{T_0}$	