EE103 HW# Oct. 23, 2017

1. Consider the *RC* circuit of Figure P4.26:

(a) The square wave of Table 4.3 is applied to the input of this circuit, with $T_0 = 2\pi$ s and $X_0 = 10$ V. Solve for the frequency spectrum of the output signal. Give numerical values for the amplitudes and phases of the first three nonzero sinusoidal harmonics.

(b) Verify the results in part (a), using MATLAB.

(c) Let the input of the circuit be as in part (a), but with a dc value of 20 V added to the square wave. Solve for the frequency spectrum of the output signal. Give numerical values for the dc component and first three nonzero sinusoidal harmonics.

(d) Is the circuit low pass? Why?

(e) The period of the square wave is changed to $T_0 = \pi$. State the effects of this change on the answers to parts (a) and (c), without solving these parts again. Give the reasons for your answers.

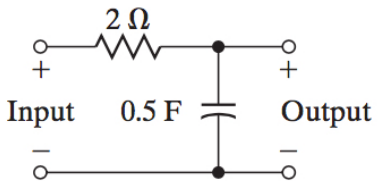
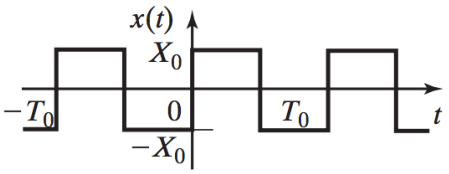


Figure P4.26

TABLE 4.3 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. Consider the system of P4.30, with $h(t) = e^{-at}u(t)$, where $\alpha > 0$. The input signal is $x(t) = \Sigma_{k=1}^{\infty} cos(kt)$. Find $y(t)$.

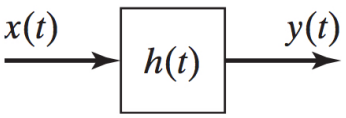


Figure P4.30