PROBLEM:

Assume that $x(t)$ is the periodic function given by

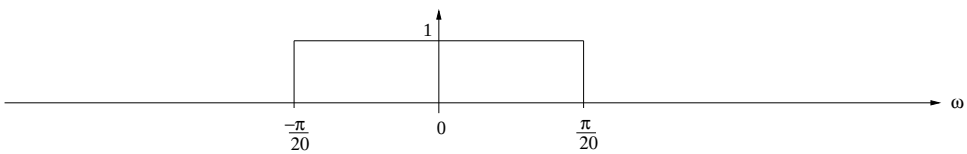
$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - 50k) = \sum_{k=-\infty}^{\infty} \frac{1}{50} e^{j\omega_0 kt}.$$

(a) Determine the value of the fundamental frequency ω_0.

$\omega_0 =$

(b) Suppose that $x(t)$ is the input to an LTI system with the frequency response illustrated below.

$$H(j\omega) = \begin{cases} 1 & |\omega| \leq \dfrac{\pi}{20} \\ 0 & |\omega| > \dfrac{\pi}{20} \end{cases}$$



Give an equation for the output of the system, $y(t)$, that is valid for $-\infty < t < \infty$. Your answer should be expressed in terms of only real quantities. (Hint: Plot the spectrum of $x(t)$ on the plot of the frequency response.)

$y(t) =$

McClellan, Schafer and Yoder, *Signal Processing First*, ISBN 0-13-065562-7.
Prentice Hall, Upper Saddle River, NJ 07458.

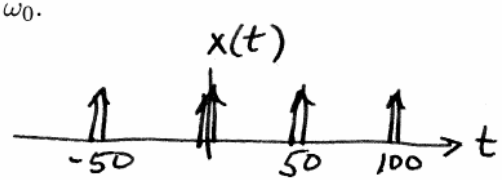
SOLUTION

Assume that $x(t)$ is the periodic function given by

$$x(t) = \sum_{k=-\infty}^{\infty} \delta(t - 50k) = \sum_{k=-\infty}^{\infty} \frac{1}{50} e^{j\omega_0 kt}.$$

(a) Determine the value of the fundamental frequency ω_0.

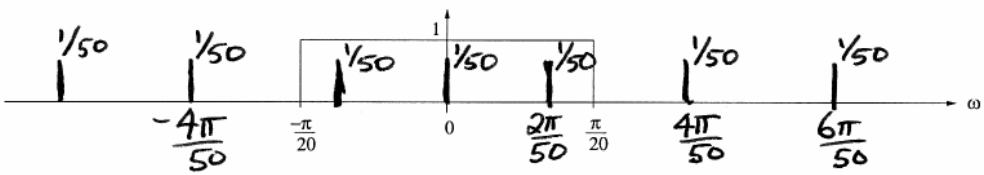
$\omega_0 = 2\pi/T = 2\pi/50$ rad/s



period = 50 sec.

(b) Suppose that $x(t)$ is the input to an LTI system with the frequency response illustrated below.

$$H(j\omega) = \begin{cases} 1 & |\omega| \leq \frac{\pi}{20} \\ 0 & |\omega| > \frac{\pi}{20} \end{cases}$$



Give an equation for the output of the system, $y(t)$, that is valid for $-\infty < t < \infty$. Your answer should be expressed in terms of only real quantities. (Hint: Plot the spectrum of $x(t)$ on the plot of the frequency response.)

$y(t) = \frac{1}{50} + \frac{2}{50}\cos\left(\frac{2\pi}{50}t\right)$

Only 3 spectrum lines are passed by the LPF

$$y(t) = \frac{1}{50} + \frac{1}{50}e^{-j\frac{2\pi}{50}t} + \frac{1}{50}e^{j\frac{2\pi}{50}t}$$