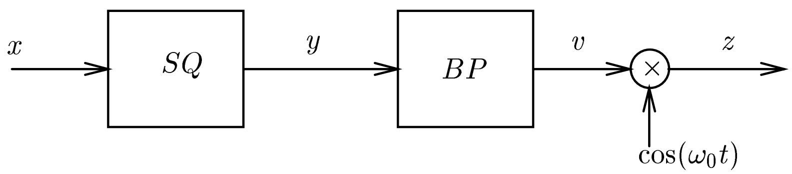
EE 102 # Homework #8 **Fall 2001**

Professor Paganini **Due 12 PM Friday 12/7/01.**
66-147F Eng IV.

1.



In the above figure:

- The input is $x(t) = 1 + \cos(\omega_0 t)$.
- The system SQ takes the square of the input, $y(t) = [x(t)]^2$.
- BP is an ideal band-pass filter, with frequency response function

$$H(i\omega) = u\Big(\omega + \frac{3}{2}\omega_0\Big) - u\Big(\omega + \frac{1}{2}\omega_0\Big) + u\Big(\omega - \frac{1}{2}\omega_0\Big) - u\Big(\omega - \frac{3}{2}\omega_0\Big)$$

- The last stage is defined by $z(t) = v(t)\cos(\omega_0 t)$.

Find the time domain functions $y(t)$, $v(t)$ and $z(t)$, and sketch the Fourier transforms $Y(i\omega)$, $V(i\omega)$, and $Z(i\omega)$.

2. (a) Find the Fourier transform of $f(t) = \frac{1}{1-it}$. *Hint:* consider duality.

   (b) Find the Fourier transform of

$$\frac{\sin(t)}{\pi t\ (1 - it)}$$

   Hint: use the previous answer and the convolution properties of the transform.

3. We are given a linear time invariant system $\mathcal{S}$ with impulse response $h(t) = u(t) - u(t - T)$, where T is a fixed constant.

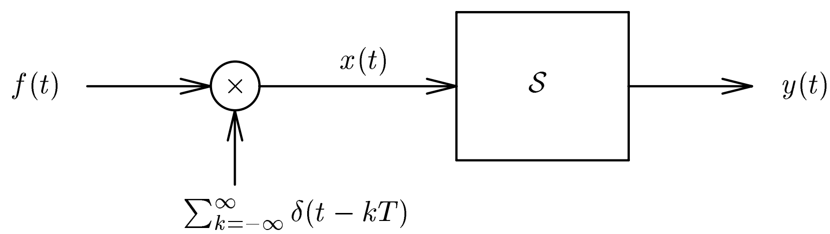
   a) Find the frequency response function $H(i\omega)$, and show it can be expressed in the form

$$H(i\omega) = e^{-i\omega\frac{T}{2}} H_R(i\omega)$$

   where $H_R(i\omega)$ is a **real** function of ω that you should determine. Sketch $H_R(i\omega)$.

b) If we apply to $\mathcal{S}$ a periodic input with period exactly equal to T: what is the output?

c) Now suppose we connect $\mathcal{S}$ in the following configuration:



Taking $f(t)$ to be the input sketched below, and $T=1$, sketch $y(t)$ in the same plot. Also write a formula for $Y(i\omega)$ in terms of $F(i\omega)$.