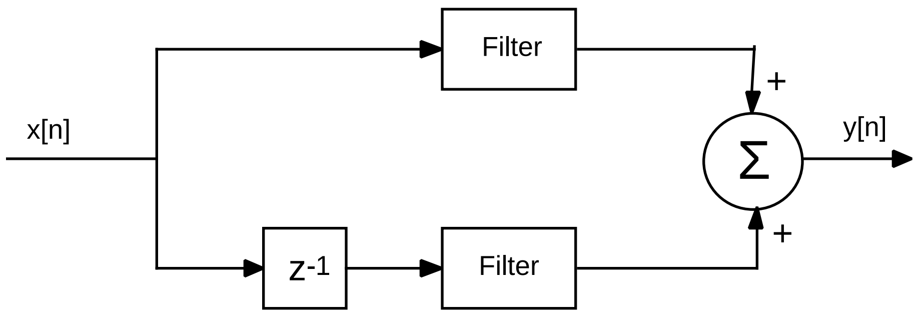
September 28, 1998 **Name:____________________**

EE 438 **Exam No. 1** **Fall 1998**

- You have 50 minutes to work the following four problems.
- Be sure to show all your work to obtain full credit.
- The exam is closed book and closed notes.
- Calculators are permitted.

1. (25 pts.) Consider the system shown below



where z^{-1} denotes a unit sample delay; and the filter is defined by the following difference equation:

$$y[n] = 0.5(x[n] + x[n-1])$$

a. (10) Find the frequency response $H(\omega)$ for the system in terms of the frequency response $F(\omega)$ of the filter

b. (5) Find a simple expression for the frequency response $F(\omega)$ of the filter. You don't need to separate it into magnitude and phase.

c. (10) Determine simple expressions for the magnitude and phase of the frequency response $H(\omega)$ of the overall system.

1. (continued)

2. (25 pts.) Consider the continuous-time signal

$$x(t) = \begin{cases} \cos[2\pi(100)t], & 2n < t \le 2n+1, \text{ for some integer } n \\ 0, & \text{else} \end{cases}$$

a. (18) Use standard functions and CTFT relations to find the CTFT $X(f)$. (Do *not* directly evaluate any integrals!)

b. (7) Sketch $|X(f)|$.

2. (continued)

3. (25 pts.). Find the convolution $z[n] = x[n] \quad y[n]$ of the two signals shown below.

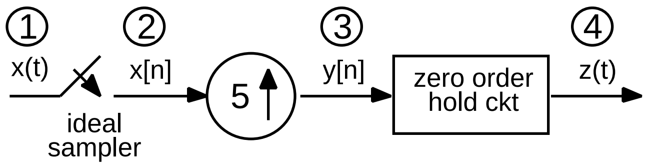
$$x[n] = \begin{cases} (-1)^n, & -N + 1 \le n \le 0 \\ 0, & \text{else;} \end{cases}$$

$$y[n] = \begin{cases} 2^{-n}, & 0 \le n \\ 0, & \text{else;} \end{cases}$$

where N is a positive integer that is greater than 1. Your answer should be valid for any such N.

3. (continued)

4. (25 pts.) Consider the signal $x(t) = \cos(2\pi(1000)t) + 0.5\cos(2\pi(8000)t)$, which is processed by the system shown below. The signal is sampled with an ideal sampler operating at a 10 kHz rate. It is then upsampled by a factor of 5, and finally reconstructed using a zero-order-hold circuit operating at a frequency of 50 kHz. Sketch the *spectra* of the signals at the circled and numbered points 1 through 4. Be sure to label all dimensions in your plots.



4. (continued)

1.	________
2.	________
3.	________
4.	________
Total	________