Name_____

Rose-Hulman Institute of Technology
Electrical and Computer Engineering

EC 380 - Exam 2 Friday, January 24th, 2003

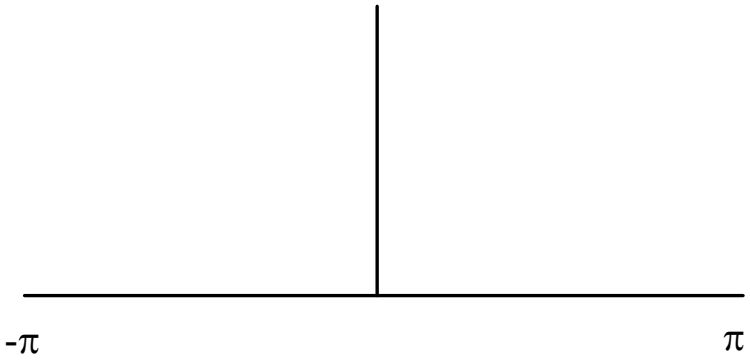
CLOSED BOOK. Work each problem in the space provided on its sheet. Be sure the work you present is clear so I can understand what you have done. One 3" x 5" card and a calculator/computer are allowed. No other aids, animate or inanimate, are permitted. Please do your own work. State answers in engineering form. **Box your answer, please, and don't forget units!**

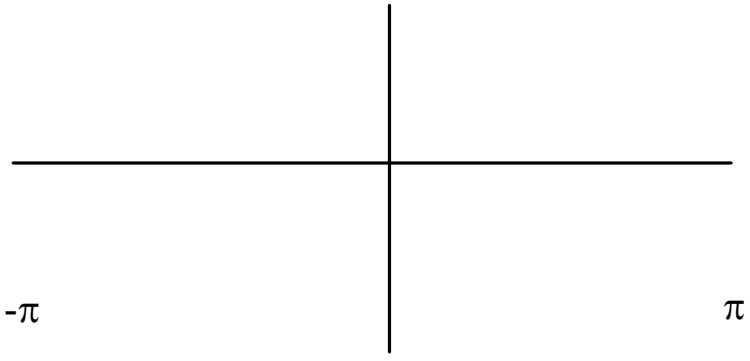
Problem 1 – [25 points] A filter is described by the following difference equation:

$$y[n] = x[n] + 2x[n-1] - 2x[n-2] - x[n-3].$$

a. Find $\mathrm{H}(e^{j\hat{\omega}})$. Express it in the magnitude/angle form we've used in class. Express complex values in polar form.

b. Suppose $\mathrm{H}(e^{j\hat{\omega}}) = 2e^{-j2\hat{\omega}}\cos(2\hat{\omega})$ Sketch $\left|\mathrm{H}(e^{j\hat{\omega}})\right|$ and $\angle\mathrm{H}(e^{j\hat{\omega}})$. Be sure to label all important frequencies and amplitudes.





Problem 2 – [25 points] The signal

$$x[n] = 5\cos\left(\frac{3}{4}\pi n\right) + 2\cos\left(\frac{1}{6}\pi n\right) + \delta[n-2]$$

is passed through the filter, y[n] = x[n] – x[n-2] + x[n-4].

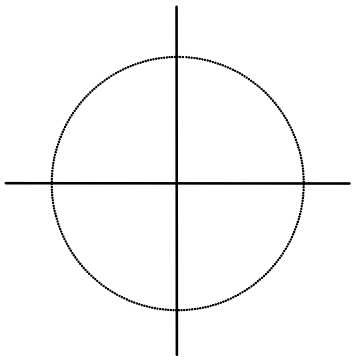
Find the output y[n]. Express it in the same form as the input.

Problem 3 – [25 points] For the system:

$$y[n] = x[n] - x[n-L]$$

a. Give the z-transform, $H(z)$,for this filter as a ratio of polynomials.

b. List and sketch the poles and zeros for L=2. Use **x**'s to mark poles and **o**'s to mark zeros.



c. Sketch the magnitude of the frequency response based on your pole/zero plot.

d. Where is/are the peak(s) on your plot (give a value for $\hat{\omega}$)? What is the value at the peak?

e. **Problem 4 –** [25 points] Find the impulse response, h[n], for the IIR filter below. Simplify h[n] so it doesn't contain δ[n]'s or other h[n]'s.

$$y[n] = a_1 y[n-1] + b_0 x[n] + b_1 x[n-1]$$

No credit unless you show and explain your work.