1. IIR filters have a feedback path and FIR filters do not. What would you expect to be the result of small errors in the formulation of the coefficients for these two systems? Would the impact of such an error be greater or less for an IIR filter? Explain.

2. What is the relationship between the Fourier transform and the Laplace transform?

3. The Fibonacci sequence is given by \{0, 1, 2, 3, 5, 8, 13, 21, 33, 54, ...\} where each term after the first two is the sum of the previous 2 terms. Find the difference equation for the sequence.

4 Suppose I have a band pass filter and I apply a step input. Since after t = 0 the input will always be 1, will the output ever go to zero? Explain.

5. Suppose you construct what is supposed to be a high pass filter in the lab. After getting things together you apply a unit step to the filter and notice that the output, after an initial transient, settles down to 2 volts. Can you conclude that your filter is working correctly or not. Explain.

6. A system has a transfer function given by \( H(z) = \frac{5}{z - 5} \)
   A) What is the impulse response in closed form?

   B) What is the corresponding difference equation?

   C) Does this represent a stable or an unstable system? Explain
7. Consider a digital system which consists of only a single unit delay as shown. Find the phase shift function for the system. Show your work.

\[ \text{angle} = -\omega T \]

8. Find the value of the magnitude and phase for each of the following systems at \( f = 0 \)Hz and at \( f = \frac{f_s}{2} \) Hz.

A) \[ H(z) = \frac{z + 2}{z^2 + z + .75} \]

For \( f = 0 \) Hz

Magnitude = _________

Phase = _________

For \( f = \frac{f_s}{2} \) Hz

Magnitude = _________

Phase = _________

B) \[ H(z) = \frac{-z - 2}{z^2 + z + .8} \]

For \( f = 0 \) Hz

Magnitude = _________

Phase = _________

For \( f = \frac{f_s}{2} \) Hz

Magnitude = _________

Phase = _________

9. A digital system has the transfer function shown below. Write the equation for the magnitude of the system at \( f = 2 \)KHz if the sample frequency is \( f_s = 8 \)KHz. Put your answer in terms of sines and cosines. You need not arrive at a number for a result – just an expression using sines and cosines.

\[ H(z) = \frac{z + 1}{z^2 - 1.4z + 0.92} \]
10. Write the state variable equations for the following second order system and determine if it is stable or not. 

\[ y_n = x_n + 0.5x_{n-1} - 0.025x_{n-2} - 0.4y_{n-1} + y_{n-2} \]

11. Answer the following questions about the filter in the figure below.

a) Is this an FIR or IIR filter? How do you know?

b) What are the first 3 terms of the impulse response sequence for this filter?

c) Write a transfer function in z for the filter.

d) What is the gain of the filter at 0Hz? 

e) What is the phase shift for the filter at 0Hz?