EE 311 **Name_____**
Hour Exam 3 **April 5, 2017**

1. What is the advantage of using the Prony or Yule-Walker direct design method over Pade's method for designing an IIR filter?

2. Apply the BLT to the following analog filter. Take ω_c = 120rad/sec. Take the sample frequency to be 200 Hz and pre-warp ω_c. Put your answer in the form of the ratio of two polynomials in Z.

$$H(S) = \frac{S}{S + \omega_c}$$

3. Answer the questions below about the transfer function. Take f_s = 5000 Hz.

A) Is this a notch filter or a resonator?_____

B) What is the center frequency?

C) What is the bandwidth?

$$H(z) = \frac{z^2 - 0.6180z + 1}{z^2 - 0.6064z + 0.9627}$$

4. Why are most band stop and band pass filters of even order.

5. Four filters F1, F2, F3, and F4 are shown below. Figure 1 shows the transition bands, Figure 2 shows the pass bands, and Figure 3 shows the stop bands. In each case the horizontal axis is frequency in Hz and the vertical axis is the gain. Answer the questions below:

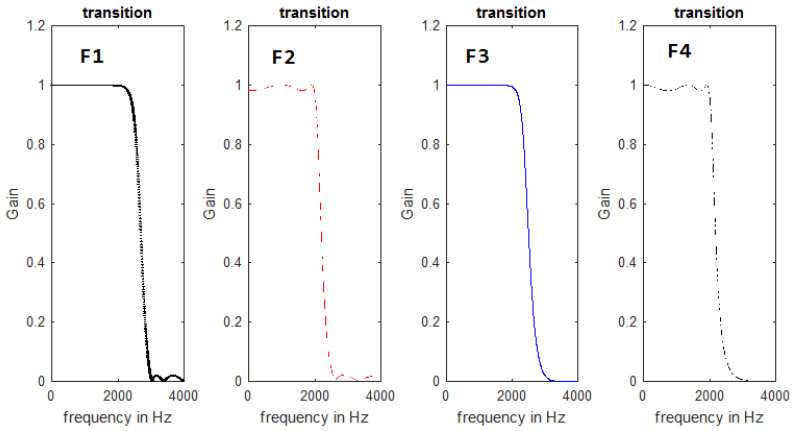


Figure 1 Transition bands

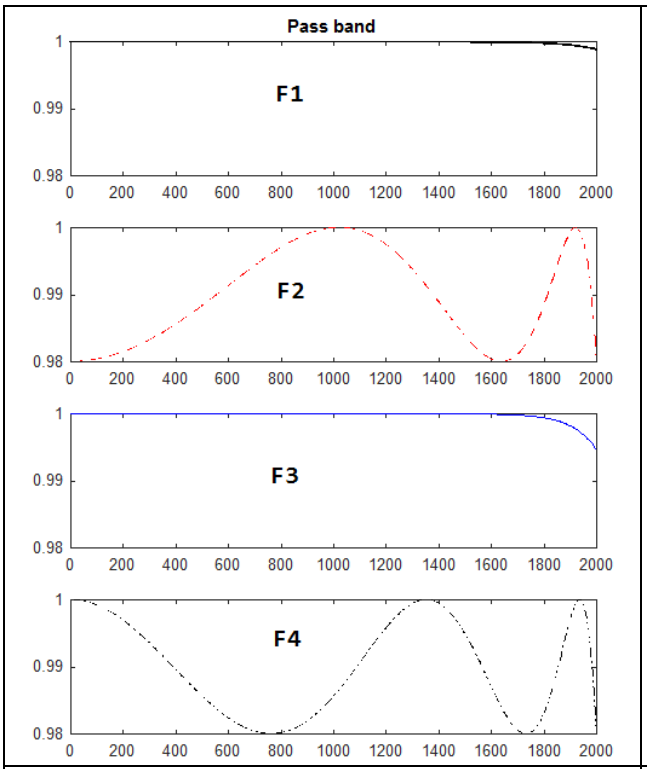


Figure 2 pass bands

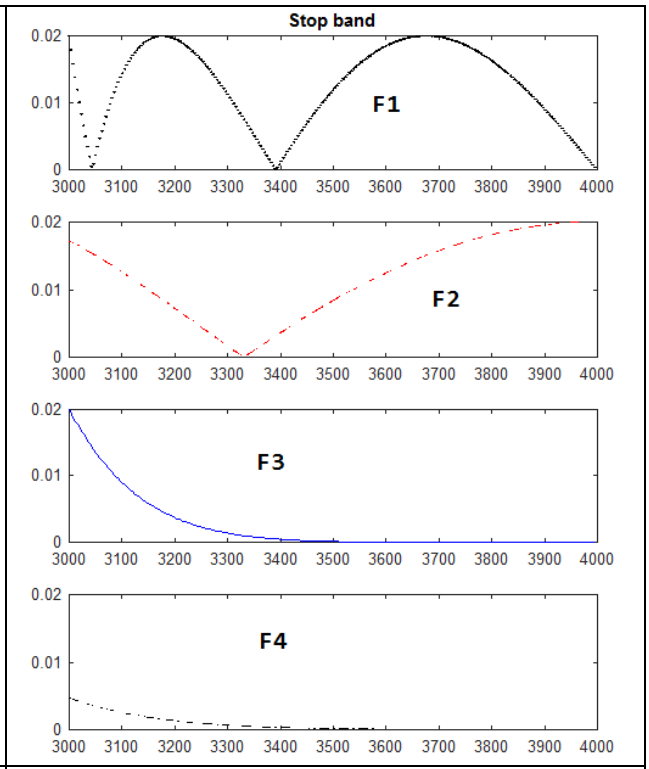
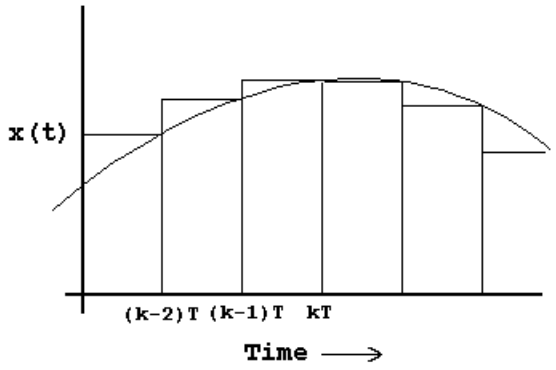


Figure 3 stop bands

A) F1 is Butterworth, Chebyshev, Inverse Chebyshev, or Elliptic (circle one)
B) F2 is Butterworth, Chebyshev, Inverse Chebyshev, or Elliptic (circle one)
C) F3 is Butterworth, Chebyshev, Inverse Chebyshev, or Elliptic (circle one)
D) F4 is Butterworth, Chebyshev, Inverse Chebyshev, or Elliptic (circle one)
E) Which filters have monotonic stop bands F1, F2, F3, F4 (circle all that apply)
F) Two of the filters have an order of 5, one has an order of 4, and one has an order of 7. Fill in the following:
Order of F1 = _____, Order of F2 = _____, Order of F3 = _____, Order of F4 = _____

6. The bilinear transform is based on approximating the area under a curve with a trapezoid. We can also approximate the area under a curve with rectangles as shown in the figure below. Find the mapping function from s to z using rectangles to approximate an integral.



7. Some low pass filters have a monotonic stop band. What readily recognizable characteristic of the pole zero plot leads to a monotonic stop band?

8. An 8^{th} order analog Butterworth filter has a cutoff frequency of 2,500Hz. What is the gain of the filter at 2,575Hz?

9. Answer the following questions for the analog filter given by:

$$H(s) = \frac{s^2 + 14s + 23}{s^4 - 12s^3 + 27s^2 - 15s + 14}$$

A) Is this filter *band limited*. Explain why or why not.

B) How many poles will be at the z = -1 point if the BLT is applied to this filter. Explain your answer.