

EE 3054: Signals, Systems, and Transforms

Lab Quiz 2 — Spring 2006

No laptop, no notes, only documentation provided allowed.

1. A discrete-time causal LTI system is simulated in MATLAB with the command `y = filter(b,a,x)`.
 - (a) Using the result of the MATLAB code fragment below, write a mathematical formula for the impulse response, $h(n)$, of the system.
 - (b) Write the transfer function $H(z)$ of the system.
 - (c) Write the difference equation of the system.

```
>> b = [8 1.6];
>> a = [1 0.4 0.13];
>> [r,p,k] = residue(b,a)
r =
     4
     4
p =
-0.2000 + 0.3000i
-0.2000 - 0.3000i
k =
     []
```

2. A discrete-time causal LTI system is described by the difference equation

$$y(n) = 3x(n) - 2x(n-1) - 0.2y(n-1).$$

Write a MATLAB code fragment that does each of the following:

- (a) makes a stem plot of the output signal produced by the input signal

$$x(n) = (0.8)^n \cos(0.2\pi n) u(n),$$

- (b) makes a plot of the frequency response magnitude $|H^f(\omega)|$,
- (c) finds just the value of $H^f(0.2\pi)$. (The value will be complex). Also write the MATLAB commands to compute $|H^f(0.2\pi)|$ and $\angle H^f(0.2\pi)$.

3. A discrete-time LTI system has transfer function

$$H(z) = 2z + 1 + 3z^{-1}.$$

Write a MATLAB code fragment to make a stem plot of the output signal produced by the input signal

$$x(n) = (0.8)^n [u(n) - u(n-5)].$$

4. A discrete-time LTI system has impulse response

$$h(n) = 0.2\delta(n) + 0.6\delta(n-1) + 0.2\delta(n-2).$$

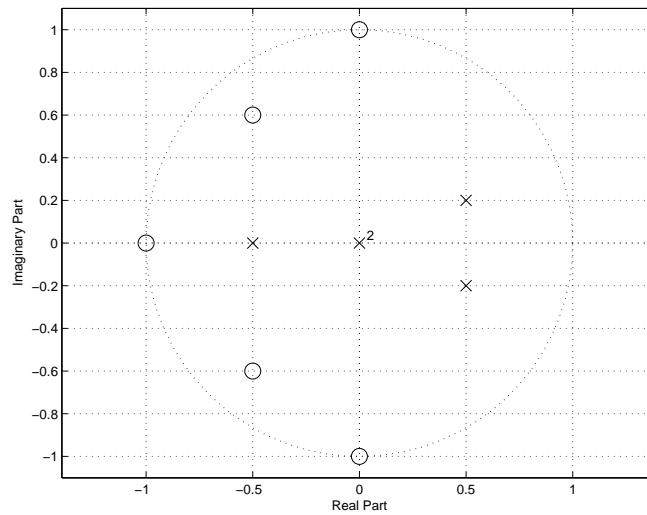
Write a MATLAB code fragment that does each of the following:

- (a) makes a stem plot of the output signal produced by the input signal

$$x(n) = \delta(n) + 2\delta(n-1) + 6\delta(n-2),$$

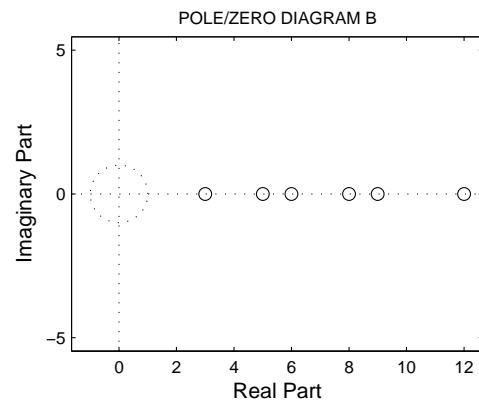
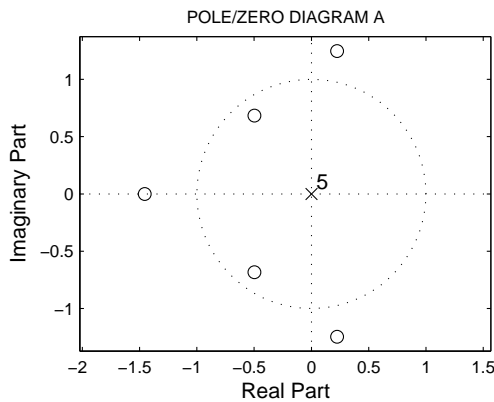
- (b) makes a plot of the frequency response magnitude $|H^f(\omega)|$.

5. Write a MATLAB code fragment to generate the coefficients $a(k)$ and $b(k)$ for the difference equation for the discrete-time LTI system having the pole/zero plot shown in the following figure.



6. The following MATLAB code fragment produces the two plots shown. Which command produces which plot? Explain.

```
>> h = [3 6 8 12 9 5]';
>> zplane(h)
>> zplane(h')
```



7. Each of the following MATLAB code fragments produce a pole/zero diagram and an impulse response plot. Indicate which two diagrams is produced by each code fragment.

<pre> CODE FRAGMENT A >> N = 20; >> x = [1 zeros(1,N)]; >> b = [1 2 0.75]; >> a = [1 -1 0.5]; >> roots(b) ans = -1.5000 -0.5000 >> roots(a) ans = 0.5000 + 0.5000i 0.5000 - 0.5000i >> figure(1) >> zplane(b,a) >> figure(2) >> y = filter(b,a,x); >> stem(0:N,y) </pre>	<pre> CODE FRAGMENT B >> N = 20; >> x = [1 zeros(1,N)]; >> b = [1 2 0.75]; >> a = [1 0 -0.5]; >> roots(b) ans = -1.5000 -0.5000 >> roots(a) ans = 0.7071 -0.7071 >> figure(1) >> zplane(b,a) >> figure(2) >> y = filter(b,a,x); >> stem(0:N,y) </pre>
<pre> CODE FRAGMENT C >> N = 20; >> x = [1 zeros(1,N)]; >> b = [1 2 0.75]; >> a = [1 -2 0.75]; >> roots(b) ans = -1.5000 -0.5000 >> roots(a) ans = 1.5000 0.5000 >> figure(1) >> zplane(b,a) >> figure(2) >> y = filter(b,a,x); >> stem(0:N,y) </pre>	<pre> CODE FRAGMENT D >> N = 20; >> x = [1 zeros(1,N)]; >> b = [1 2 0.75]; >> a = [1 1 -0.9]; >> roots(b) ans = -1.5000 -0.5000 >> roots(a) ans = -1.5724 0.5724 >> figure(1) >> zplane(b,a) >> figure(2) >> y = filter(b,a,x); >> stem(0:N,y) </pre>

Figure A

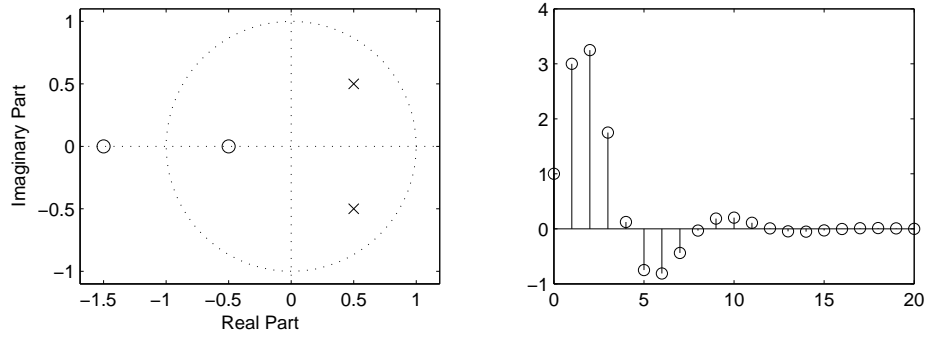


Figure B

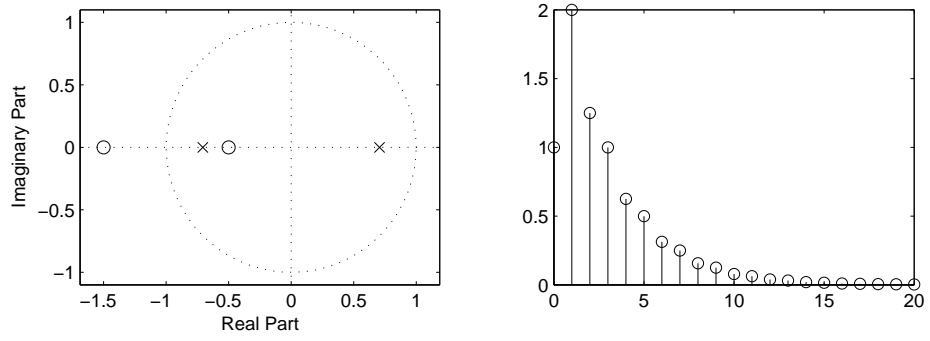


Figure C

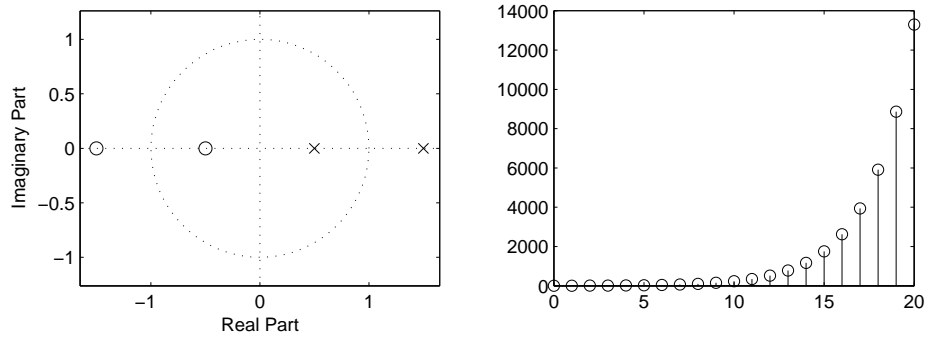


Figure D

