Homework for Module 4 Part 2

Quiz, 9 questions

1 point

1.
(Difficulty: ⋆) Consider the following causal CCDE

$$y[n] + 2y[n-1] = 3\,x[n] + 2.5\,x[n-1].$$

Which of the following statements are correct?

- [ ] Its ROC contains the unit circle.
- [ ] If the input signal is $\delta[n] - \delta[n+1]$, then the z-transform of the output would be $(-3z + 1/2 + 5/2z^{-1})/(1+2z^{-1})$.
- [ ] It has two poles at -2 and $\frac{-5}{6}$.
- [ ] The system is stable.

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1 point

2.
(Difficulty: ⋆⋆) Suppose that the ROC of the sequence $x[n]$ is $r_L < |z| < r_U$. What is the ROC of $x^*[-n]$?

- ○ $r_L < |z| < r_U$
- ○ $r_U < |z| < r_L$
- ○ $\frac{1}{r_U} < |z| < \frac{1}{r_L}$
- ○ $\frac{1}{r_L} < |z| < \frac{1}{r_U}$

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1 point

3.
(Difficulty: ⋆) Consider an LTI system $h[n]$, whose transfer function's ROC is R_h. Consider a second LTI system $g[n]$ with ROC R_g. Now consider the cascade of the two filters.

What is the ROC of the cascade?

- ○ It contains $R_g \cup R_h$.

- It is only R_g.

- It is only R_h.
- It contains $R_g \cap R_h$.

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1 point

4.
(Difficulty: ⋆) Consider the following CCDE

$$y[n] - \frac{1}{2}y[n-1] = 2x[n] - 5x[n-1] - x[n-2].$$

Let $H(e^{j\omega})$ denote the transfer function of this system. What is $H(e^{j\pi})$?

Enter answer here

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1 point

5.
(Difficulty: ⋆⋆) Write some code in your preferred programming language that implements the following CCDE:

$$y[n] + 2y[n-1] = x[n+1] - \frac{1}{2}x[n]$$

Use $y[n] = 0$ for $n < 0$ as initial conditions and run the algorithm for $x[n] = \delta[n] + \frac{1}{2}\delta[n-1]$.

- $y[5] = 1$
- The filter is stable but the output $y[n]$ diverges because of the chosen input $x[n]$.
- The output shows a diverging oscillation around zero: as n grows, it assumes always larger values with alternated signs.
- The filter is mathematically unstable. Even in practice, you can see the output diverging $|y[50]| > 10^{13}$.
- $y[4] = 2$

---

1 point

6.

(Difficulty: ⋆⋆⋆) A filter $H(z)$ has the following pole-zero plot:

Homework for Module 4 Part 2

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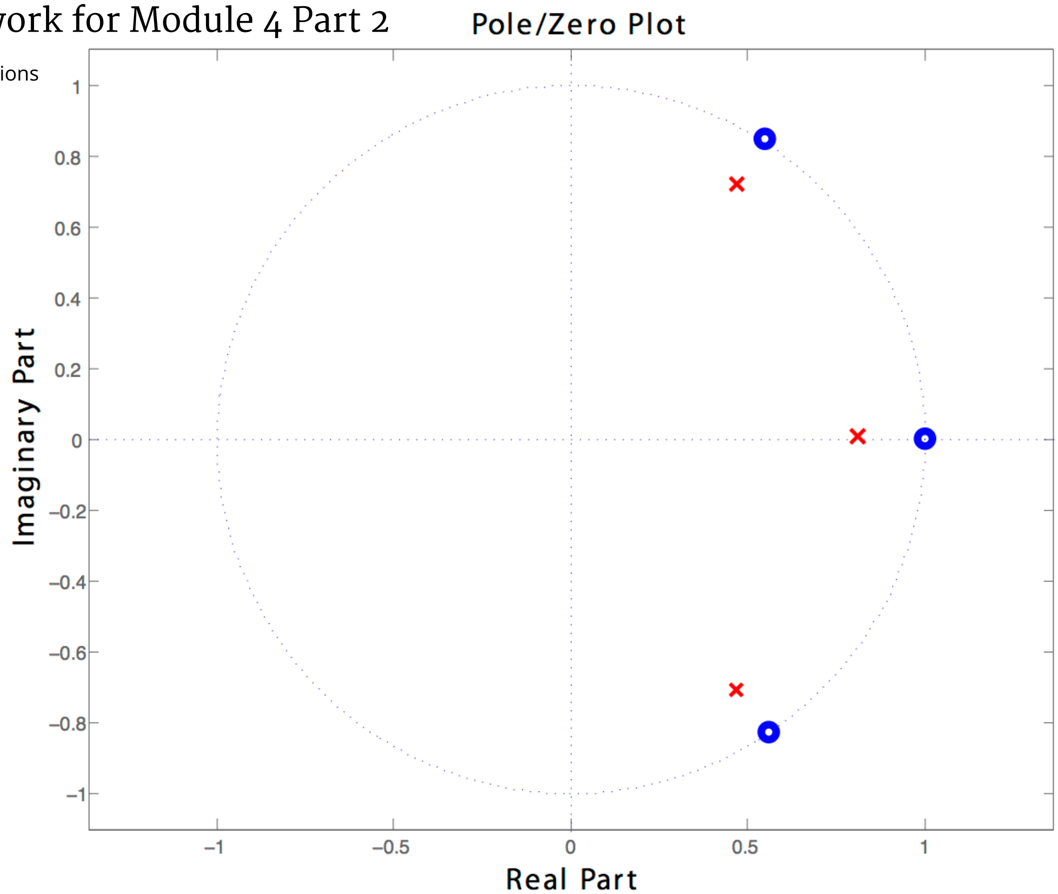
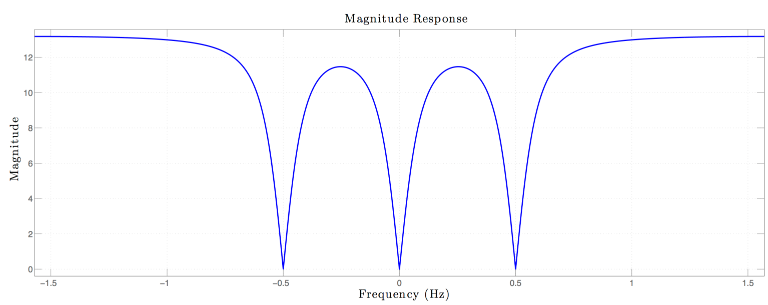
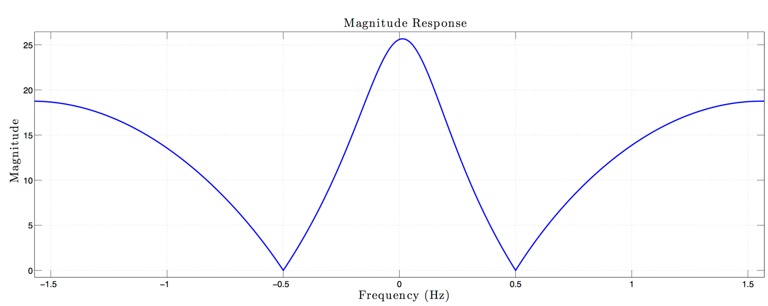


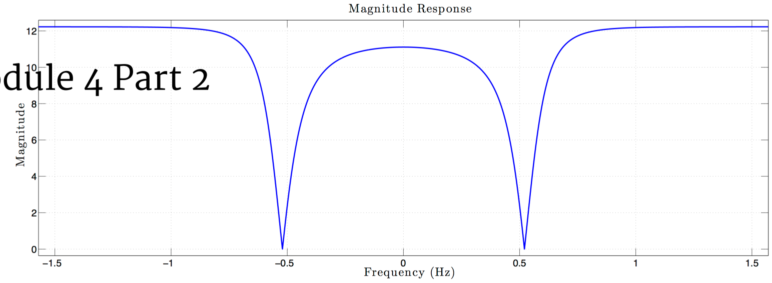
Which of the following figures shows the magnitude response of the filter? Assume an implementation where the "internal clock" is $T_s = 1s$ so that the frequency axis is labeled in Hz and 1Hz corresponds to the digital frequency of $\omega = 1$ radians.



Magnitude response



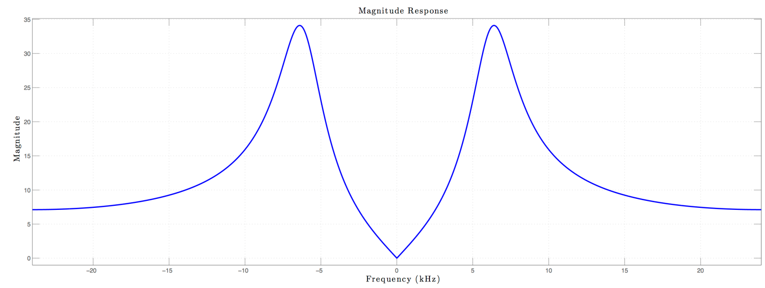
Magnitude response



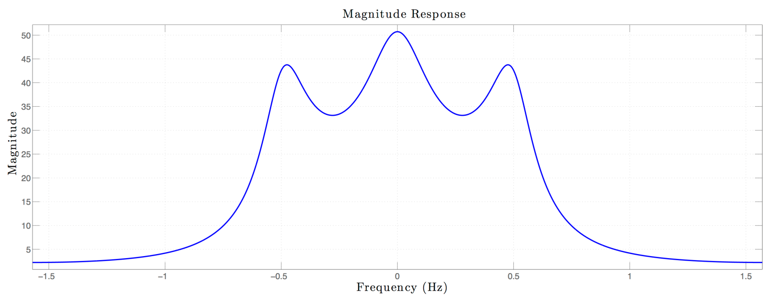
Homework for Module 4 Part 2

Quiz, 9 questions

Magnitude response



Magnitude response



Magnitude response

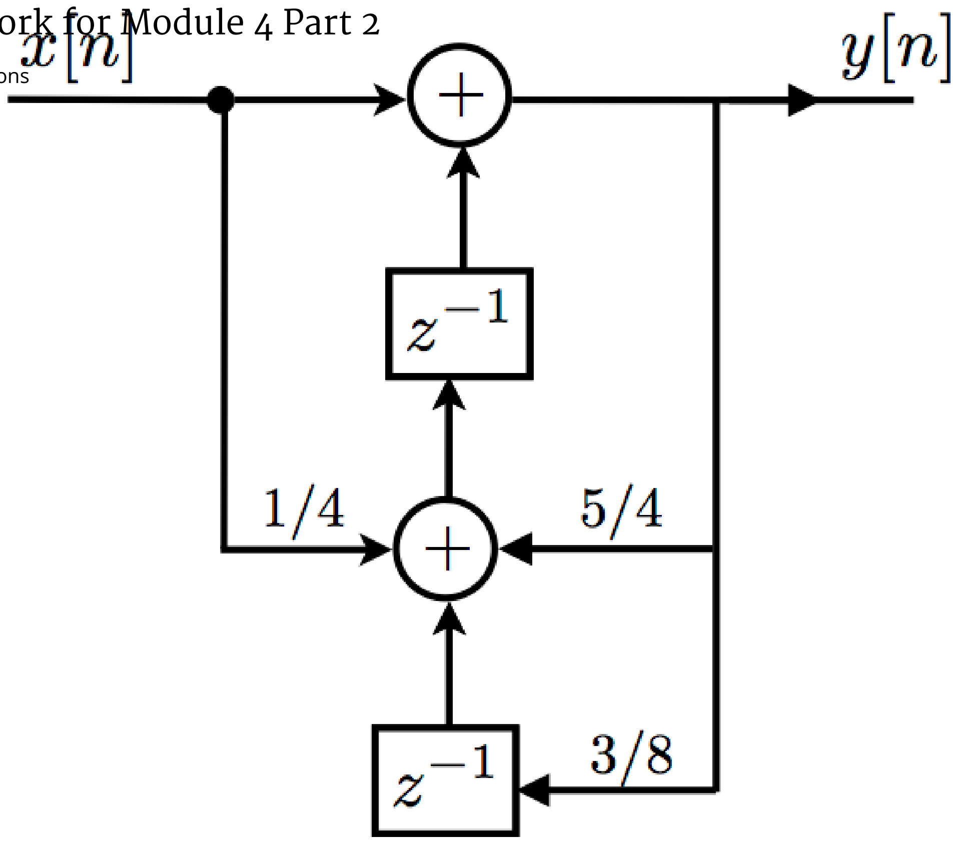
1 point

7.

(Difficulty: ⋆⋆) Let $h[n]$ represent the impulse response of the following system.

- Homework for Module 4 Part 2

Quiz, 9 questions



Select the correct statement about the poles and zeros of $H(z)$.

- $H(z)$ has two zeros at $z_1 = 5/4$ and $z_2 = 3/8$ and one pole at $z_3 = 1/4$.
- It has one pole at $z_1 = 3/2$
- $H(z)$ has one zero at $z_1 = 1/4$ and two poles at $z_3 = 5/4$ and $z_2 = 3/8$.
- It has one zero at $z_1 = 3/2$ and one pole at $z_2 = 5/6$.
- It has one zero at $z_1 = -3/4$.

1 point

8.

(Difficulty: ⋆⋆) The following bit of Python code implements a discrete-time filter (assume $x[n]$ and $y[n]$ are suitably defined arrays):

```
f = 0;
g = 0;
for n in range(0, L-1):
    y[n] = x[n] + f;
    g = -f;
    f = -x[n] + 0.5 * y[n] + g;
```

What is the minimum number of delays necessary to implement this filter efficiently?

Enter answer here

Homework for Module 4 Part 2

Quiz, 9 questions

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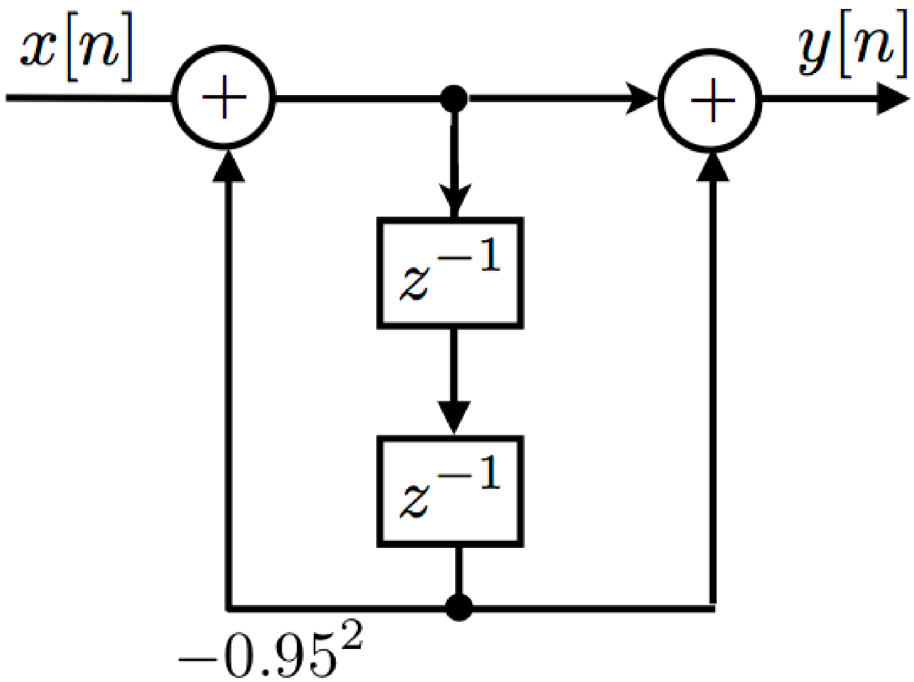
9.

(Difficulty: ⋆⋆) Which of the following statements describes the system in this figure?



- The system is a hum removal filter with $\omega_0 = 3\pi/4$.
- The system is a hum removal filter with $\omega_0 = \pi/2$.
- This is a resonator at $\omega_0 = \pi/2$.
- The system is a resonator at $\omega_0 = 3\pi/4$.
- The system is a DC notch.
- None of these statements describe this system.

I, **Mark R. Lytell**, understand that submitting work that isn't my own may result in permanent failure of this course or deactivation of my Coursera account.

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