Name:

Problem	Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
6	10	
7	10	
8	10	
9	10	
10	10	
TOTAL	100	

What grade do you think you deserve in this course? ______________

Explain why:

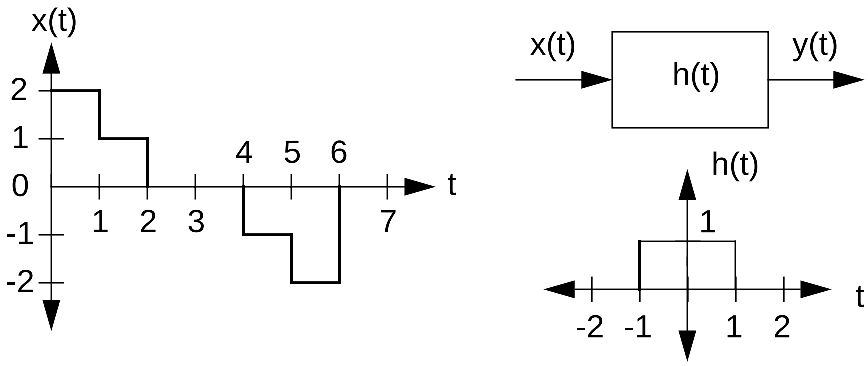
Notes:

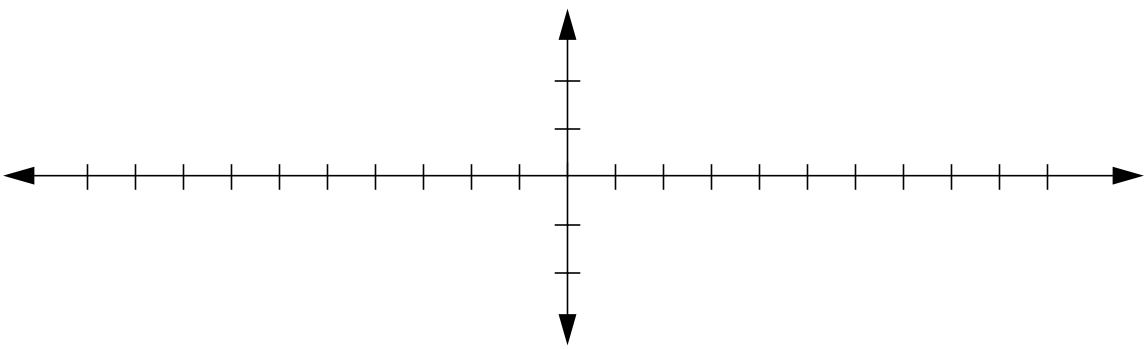
1. The exam is closed books/closed notes - except for four pages of notes.

2. Please show ALL work. Incorrect answers with no supporting explanations or work will be given no partial credit.

3. Please indicate clearly your answer to the problem.

Problem No. 1: For the system shown, plot $y(t)$. Explain any symmetry you observe in the output using linear system theory.



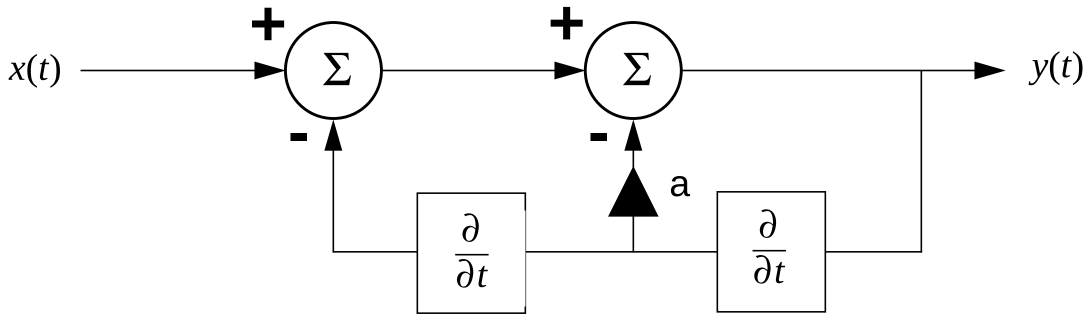


Explanation:

Problem No. 2: Construct the Bode plots for the amplitude spectrum for the two systems shown below. Explain any similarities or differences between the two systems.

$$H_1(s) = \frac{1}{s^2 + 2s + 2} \qquad H_2(s) = \frac{1}{s^2 - 2s + 2}$$

Problem No. 3: For the system shown below, construct a plot in the s-plane showing the poles of the system for $-2 \le a \le 2$, where a is a real constant. Clearly indicate for which subset of these poles the system is stable. Assume zero initial conditions and then explain what would happen if the initial conditions were not zero, but $x(t) = 0$ for $t < 0$.



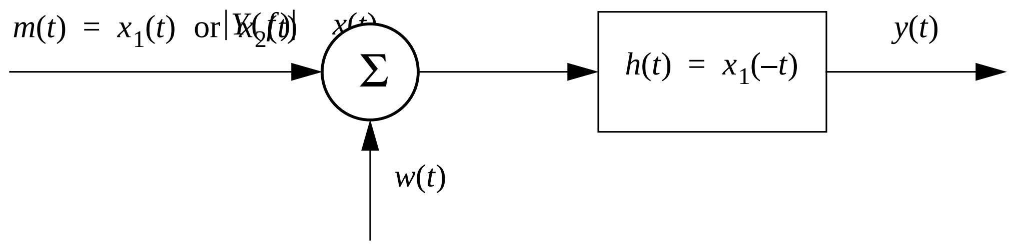
Problem No. 4: Use the Routh criterion to determine how many right-half-plane poles the following system has:

$$H(s) = \frac{1 - 3s + 6s^2}{s^5 + 4s^4 + 3s^3 + 2s^2 + s + 1}$$

Problem No. 5: The communications system shown below can send one of two signals, $x_1(t)$ and $x_2(t)$, called messages. During transmission of the signal, a certain amount of white noise is added. White noise is defined as a signal that has a flat power spectrum and is uncorrelated with the messages:

$$\int_{-\infty}^{\infty} x_i(t)w(t-\tau)dt = 0 \quad \text{and} \quad \int_{-\infty}^{\infty} w(t)w(t-\tau)dt = 0 \qquad \tau \neq 0 .$$

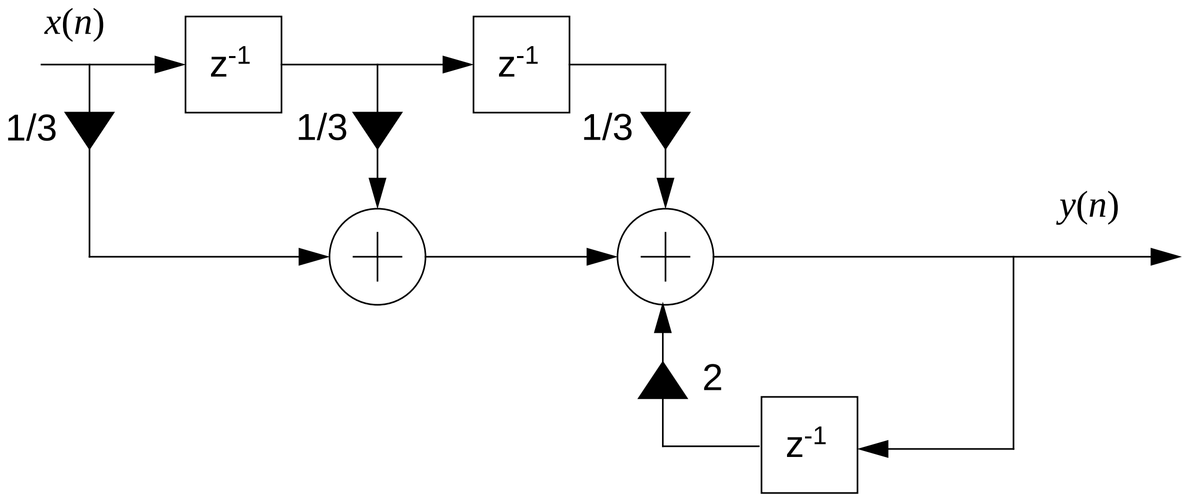
Assume the messages are orthogonal. Compute the output when each message is sent, and discuss the implications of this result. Comment on whether this system as shown below is practical (can be implemented in real-time).



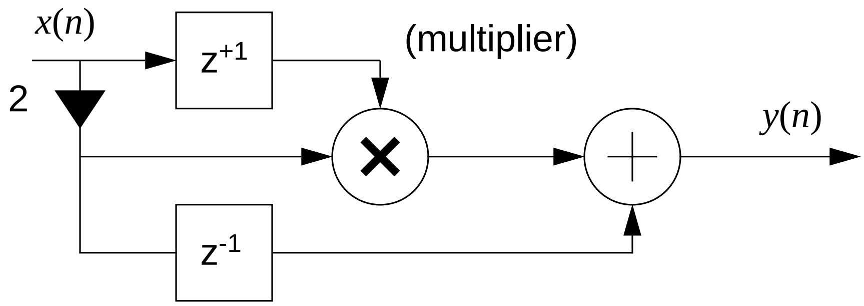
Problem No. 6: Prove the time-delay theorem for the Z-transform:

$$Z\{x(n-k)\} = z^{-k}X(z)$$

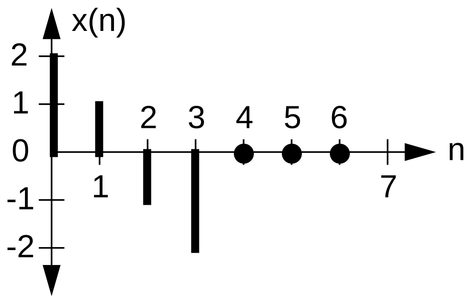
Problem No. 7: Compute the impulse response of the discrete-time system shown below two ways: (1) by applying an impulse to the system, (2) by computing the transfer function.

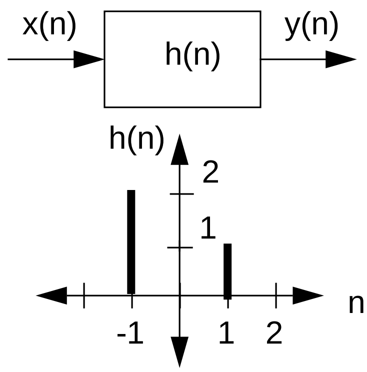


Problem No. 8: Using as many of the basic concepts discussed in Net III (linearity, superposition, etc.), describe the system below as completely as possible.



Problem No. 9: Compute the output for the system shown below:





Problem No. 10: Assume $x(n)$ was sampled at 1 kHz. Compute the value of the magnitude spectrum at 127 Hz. Be sure to clearly indicate your approach to this problem, or you may lose significant partial credit.