Part 1 (Multiple-choice questions): For problems in this part, you only have to give the letter of the correct answer (A/B/C/D). Explanations are not required.
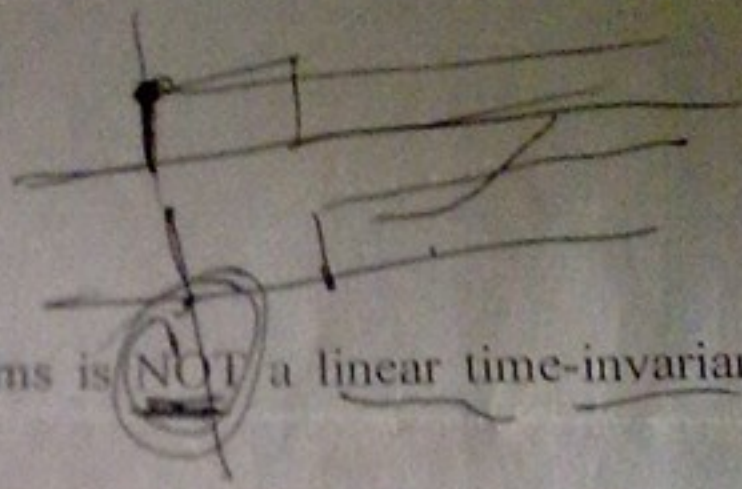
Problem 1. Which one of the systems described by the following impulse responses is both causal and stable?

A. $h(t) = \sin(3\pi t)[u(t+1) - u(t-1)]$

B. $h(n) = (1/3)^n [u(n) - u(2n-1)]$
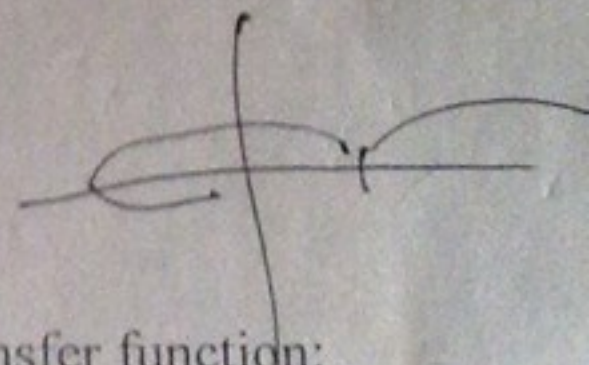
C. $h(n) = -nu(n)$

D. $h(t) = e^{2t} u(t/2)$

Problem 2. Which one of the following systems is NOT a linear time-invariant system?

A. $\dfrac{dy(t)}{dt} + 2y(t) = \dfrac{dx(t)}{dt} + x(t)$

B. $y(n) + y(n-1) = 2^n x(n)$ not invariant

C. $\dfrac{d^2 y(t)}{dt^2} - \dfrac{dy(t)}{dt} = -x(t)$

D. $y(n) - y(n-1) + 2y(n+1) = x(n-1)$

Problem 3. Given a system described by the following transfer function:

$$X(s) = \frac{2s+1}{s^2 + 3s + 2} \qquad -1; -2$$

Which one of the following statements about this system is NOT correct?

A. This system can be both causal and stable.

B. This system can not be both non-causal and stable.

C. If this system is causal then its frequency response exists.

D. If this system is non-causal then its frequency response exists.

Problem 4. Which one of the following statements is NOT correct?

A. A stable linear time-invariant system can not have a periodic impulse response

tín hiệu đầy số, nếu lượng giới hạn

B. The frequency response of a stable linear time-invariant system is the Fourier transform of its impulse response.

C. The frequency response of a stable discrete-time linear time-invariant system is discrete.

$$H(\Omega) = \frac{1}{2\pi}\sum_{?} x(v)$$

D. The frequency response of a stable discrete-time linear time-invariant system is continuous.

Part 2 (Exercises). *For problems in this part, detailed explanations/derivations that lead to the answer must be provided.*

Problem 5. Given a causal linear time-invariant system described by the following differential equation:

$$\frac{d^2 y(t)}{dt^2} + 3\frac{dy(t)}{dt} + 2 y(t) = x(t) - \frac{dx(t)}{dt}$$

a) Determine the transfer function of the given system.
b) Determine the impulse response of the given system.
c) Determine the step response of the system.

Problem 6. Given a system **T** described by the following block diagram:
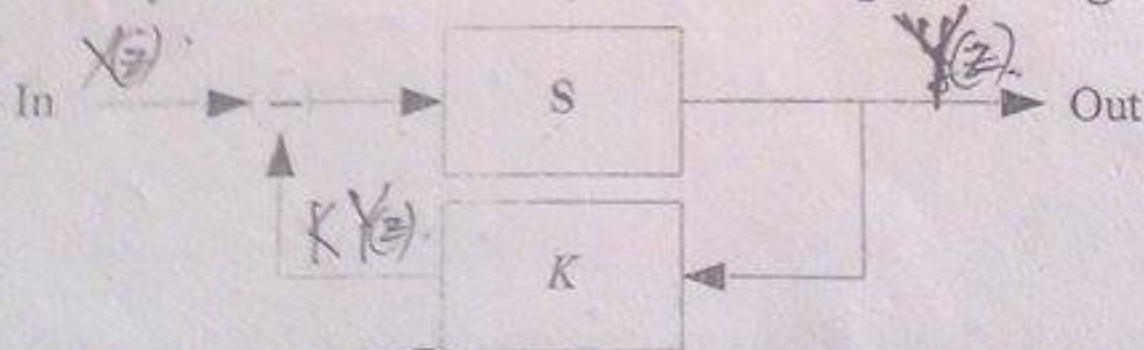
in which, **S** is a discrete-time causal linear time-invariant system described by the difference equation $y(n)+2 y(n-1)=x(n-1)$ and K is a real value.

a) Determine the transfer function of **T**.
b) Determine the frequency response of **T** (if it exists) when $K = 1$ and when $K = -2$.
c) Determine the condition for K so that **T** is stable.

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