VIETNAM NATIONAL UNIVERSITY, HANOI
University of Engineering and Technology

Date: May 27, 2014

FINAL EXAMINATION
Course: **Signals and Systems**
Duration: 90 minutes

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

Answer: B (1 point)

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

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

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

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

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

Answer: B (1 point)

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

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

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.

Answer: D (1 point)

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.

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.

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

Answer: C (1 point)

***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.

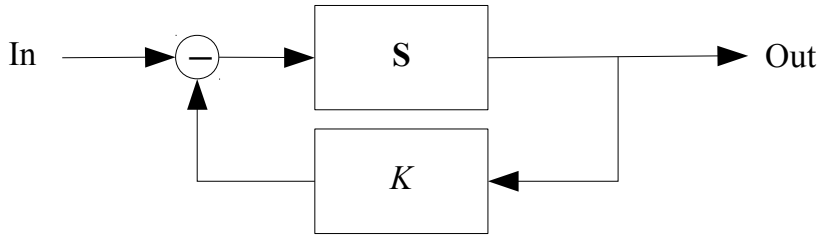
Answer:

a) $H(s)=\dfrac{1-s}{s^2+3s+2}$ *(1 point)*

b) $h(t)=(2e^{-t}-3e^{-2t})u(t)$ *(1 point)*

c) $y(t)=(\dfrac{1}{2}-2e^{-t}+\dfrac{3}{2}e^{-2t})u(t)$ *(1 point)*

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.

Answer:

a) $H(z)=\dfrac{K}{z+K+2}$ *(1 point)*

b) $K = 0$: not exist, $K = -2$: $H(\Omega)=-2e^{-j\Omega}$ *(1 point)*

c) $-3<K<-1$ *(1 point)*

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