DSP Practice Test #1.D

Name: _____ Start Time: _____

Problem 1:

For the system with the input-output relation:

$y[n] = T\{x[n]\} = \sum_{k=-\infty}^{\infty} \left(x[k] e^{-2(n-k)} u[n-k] \right)$ determine the properties of the system

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A) The system is Linear/ Nonlinear / Not Enough Info

B) The system is Causal / Noncausal / Not Enough Info

C) The system is Time-variant / Time-Invariant / Not Enough Info

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D) The system is Stable / Unstable / Not Enough Info

Problem 2:

An LTI system has an impulse response defined by:

$h[n] = -\delta[n+8] + \delta[n-1] + e^{-n}u[n].$

Determine and sketch the output $y[n]$ when the input is $x[n] = u[n]$

Problem 3:

Consider an LTI system defined by the difference equation

$$y[n] - y[n-2] = -2x[n] + 5x[n-1] - 2x[n-2]$$

A) Determine the z-transform of this system $H(z)$

B) Determine the frequency transform of this system $H\left(e^{j\omega}\right)$

C) Suppose that the input to the system is

$$x[n] = -3 + e^{j0.2\pi n} + \cos(.3\pi n) + (-1)^n,\ n \in \mathbb{Z}$$

D) Determine the impulse response of this system, $h[n]$

Problem 4:

Consider a random signal $x[n] = s[n] + e[n]$, where $s[n]$ and $e[n]$are stationary random signals

- with non-zero means, μ_s and μ_e respectively
- Are non-independent with covariances $K = \begin{bmatrix} \sigma_s^2 & \rho\sigma_s\sigma_e \\ \rho\sigma_s\sigma_e & \sigma_e^2 \end{bmatrix}$
- with autocorrelation functions $\phi_{ss}[m]$and $\phi_{ee}[m]$,
- and crosscorrelation function $\phi_{se}[m] = \phi_{es}[m]$.

A) Determine the mean of $x[n]$, μ_x

B) Determine the standard deviation of of $x[n]$, σ_x

C) Determine the autocorrelation function $\phi_{xx}[m]$, in terms of $\phi_{ss}[m]$, $\phi_{ee}[m]$, and $\phi_{se}[m]$. Simplify your expression as much as possible.