Name: SOLUTIONS

Quiz 3: 10 /10 **ELEC 309 – Signals & Systems**

A discrete-time system has $y[-1] = 0$ and is given by

$$y[n] - y[n-1] = x[n].$$

(a) (5 points) Determine the impulse response $h[n]$. [*Hint: Use the recursive approach.*]

Note that $y[n] - y[n-1] = x[n] \Longrightarrow h[n] - h[n-1] = \delta[n]$.

Also, $h[n] = h[n-1] + \delta[n]$ and $h[n-1] = h[n] - \delta[n]$.

For $n < 0$,

$$\begin{aligned} h[-1] &= y[-1] = 0 \\ h[-2] &= h[-1] - \delta[-1] = 0 - 0 = 0 \\ h[-3] &= h[-2] - \delta[-2] = 0 - 0 = 0 \\ h[-4] &= h[-3] - \delta[-3] = 0 - 0 = 0 \\ &\vdots \\ h[n] &= 0. \end{aligned}$$

For $n \geq 0$,

$$\begin{aligned} h[0] &= h[-1] + \delta[0] = 0 + 1 = 1 \\ h[1] &= h[0] + \delta[1] = 1 + 0 = 1 \\ h[2] &= h[1] + \delta[2] = 1 + 0 = 1 \\ h[3] &= h[2] + \delta[3] = 1 + 0 = 1 \\ &\vdots \\ h[n] &= 1. \end{aligned}$$

Therefore,

$$\boxed{h[n] = u[n].}$$

(b) (1 point) This system is

A. $\boxed{\textbf{an LTI system, since } y[-1] = 0\textbf{.}}$

B. not an LTI system.

(c) (1 point) This system is

A. an FIR system.

B. $\boxed{\textbf{an IIR system, since } h[n] \neq 0 \textbf{ for } 0 \leq n < \infty\textbf{.}}$

(d) (1 point) This system

A. is memoryless.

B. $\boxed{\textbf{has memory, since } h[n] \neq 0 \textbf{ for } 0 \leq n < \infty\textbf{.}}$

(e) (1 point) This system is

A. $\boxed{\textbf{causal, since } h[n] = 0 \textbf{ for } n < 0\textbf{.}}$

B. non-causal.

(f) (1 point) This system is BIBO

A. stable.

B. $\boxed{\textbf{unstable, since } \sum_{n=-\infty}^{\infty} |h[n]| = \sum_{n=0}^{\infty} 1 = \infty\textbf{.}}$