جامعة بيرزيت

BIRZEIT UNIVERSITY

Faculty of Engineering and Technology

Electrical and Computer Engineering

DSP (Fall 2021) - Quiz (1)

10

Name: Tareq Shannak ID: 1181404

a) A linear time-invariant system is described by the following difference equation:

$$y[n] = x[n] - \frac{1}{2}x[n-1]$$

(i) Determine h[n], the impulse response of the system.

(ii) Is this a stable system?

(iii) Find the system response, y[n], of the following input signal: $x[n] = \left(\frac{1}{2}\right)^n u(n)$

2

(i) $x(n) = \delta(n) \Rightarrow y(n) = \delta(n) - \frac{1}{2}\delta(n-1) = h(n)$

$h(n) = [1, -0.5]$

(ii) stable, BIBO. 1

when $\lim_{n\to\infty} x[n] < K < \infty$, $\lim_{n\to\infty} y[n] < K < \infty$

It doesn't depend on past output (No feedback)

(iii) $y(n) = x(n) * h(n) = \left[\left(\frac{1}{2}\right)^n u(n)\right]\left[\delta(n) - \frac{1}{2}\delta(n-1)\right]$

3 $= \left(\frac{1}{2}\right)^n u(n) - \frac{1}{2}\left(\frac{1}{2}\right)^{n-1} u(n-1) = \left(\frac{1}{2}\right)^n u(n) - \left(\frac{1}{2}\right)^n u(n-1)$

$= \left(\frac{1}{2}\right)^n [u(n) - u(n-1)] = \left(\frac{1}{2}\right)^n \delta(n)$ $= \delta(n)$

b) Determine if the following discrete-time signal $x(n) = \sin(\frac{15}{36}\pi n + \frac{\pi}{4})$ is periodic or non-periodic? If periodic, find its fundamental period? [4pts]

$w = \frac{15}{36}\pi$

$x(n) = \cos(wn - \frac{\pi}{4})$, $w = \frac{15}{36}\pi$

4 $w_0 N = 2\pi K \Rightarrow N = \frac{2\pi K}{\frac{15}{36}\pi} = \frac{\cancel{72}^{24}}{\cancel{15}_{5}} K$

$K = 5 \Rightarrow$ the Period of $N = 24 \Rightarrow$ fundamental Period $= 24$

$\hookrightarrow$ ✓ Periodic.