Solution

Faculty of Information Technology

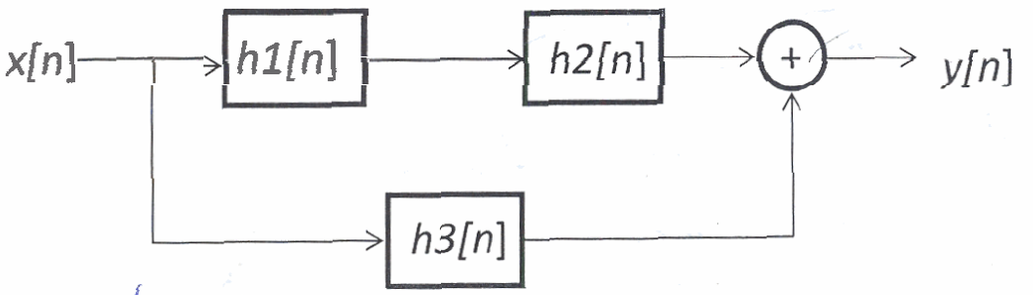
Computer Systems Engineering

ENCS431 (DSP) Fall Semester **2012/2013**

Name: **ID:**

QUIZ #1

(1) Determine the overall impulse response of the following system, where the impulse response of the component systems are: $h1[n] = 2\delta[n-1] - \delta[n] + 3\delta[n+1]$, $h2[n] = \delta[n-1] + 2\delta[n+2]$, and $h3[n] = 5\delta[n-5] + 7\delta[n-3] + 2\delta[n-1] - \delta[n] + 3\delta[n+1]$.



[1] $h(n) = (h_1(n) * h_2(n)) + h_3(n)$

[1] $h_1(n) * h_2(n) = (2\delta(n-1) - \delta(n) + 3\delta(n+1)) * (\delta(n-1) + 2\delta(n+2))$

$= 2\delta(n-2) - \delta(n-1) + 3\delta(n) + 4\delta(n+1) - 2\delta(n+2) + 6\delta(n+3)$

[2]

$\therefore h(n) = 5\delta(n-5) + 7\delta(n-3) + 2\delta(n-2) + \delta(n-1) + 2\delta(n) + 7\delta(n+1) - 2\delta(n+2) + 6\delta(n+3)$

[6 Marks]

(2) Determine whether the system $y[n] = \sum_{k=n-20}^{n+5} x[k]$ is: **i) LTI,** **ii) Stable,** **iii) Causal**

[3] ① linear

Let $y_1(n) = \sum_{k=n-20}^{n+5} x_1(k)$ and $y_2(n) = \sum_{k=n-20}^{n+5} x_2(k)$ and

$x_3(n) = a x_1(n) + b x_2(n)$

$\Rightarrow y_3(n) = \sum_{k=n-20}^{n+5} a x_1(k) + b x_2(k) = a y_1(n) + b y_2(n)$

So, system is linear ⟹ turn over

I: $y(n) = \sum_{k=n-20} x(k)$

$$y(n-n_0) = \sum_{k=n-n_0-20}^{n-n_0+5} x(k) = \sum_{k=n-20}^{n+5} x(k-n_0)$$

Let $x_1(n) = x(n-n_0)$

$$\Rightarrow y_1(n) = \sum_{k=n-20}^{n+5} x(k-n_0) = y(n-n_0)$$

So, System is TI.

Stable: if $x(n)$ is bounded, i.e. $|x(n)| < \infty$

$$|y(n)| = \sum_{k=n-20}^{n+5} |x(n)| \leq |x(n)| \cdot 25 < \infty$$

So, $y(n)$ is also bounded, i.e. $|y(n)| < \infty$

∴ System is stable.

) Causal since $y(n)$ depends on future samples of $x(n)$

⇒ System is non causal