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King Mongkut's University of Technology Thonburi

Midterm Examination 1/2018

CPE 315 Signals and Linear Systems **Computer Engineering Department**
Date: October, 2 2018 **Time: 1:00 – 4:00 p.m.**

Instructions:

Violation of examination rules and regulations will not be tolerated. Serious violator could face dismissal charge.

1. **Only one calculator and one ruler with mathematical formula are allowed** in the examination room.
2. **Books, documents, and notes are not allowed** in the examination room.
3. Carefully read the explanation in each problem and then answer each question.
4. **Do not take the examination sheets out** of the examination room.
5. Write your answers on the examination booklet(s).
6. This examination has **6 pages (6 problems, 40 points)**.

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ข้อสอบนี้ได้ผ่านการพิจารณาจากคณะกรรมการภาควิชาวิศวกรรมคอมพิวเตอร์

(รศ.ดร.พีรพล ศิริพงศ์วุฒิกร)

ประธานหลักสูตร

วันที่.....เดือน.....พ.ศ.....

1. Consider and **LTI** system whose response to the signal $x_1[n]$ in Figure 1 a) is the signal $y_1[n]$ in Figure 1 a) ***(10 points)***

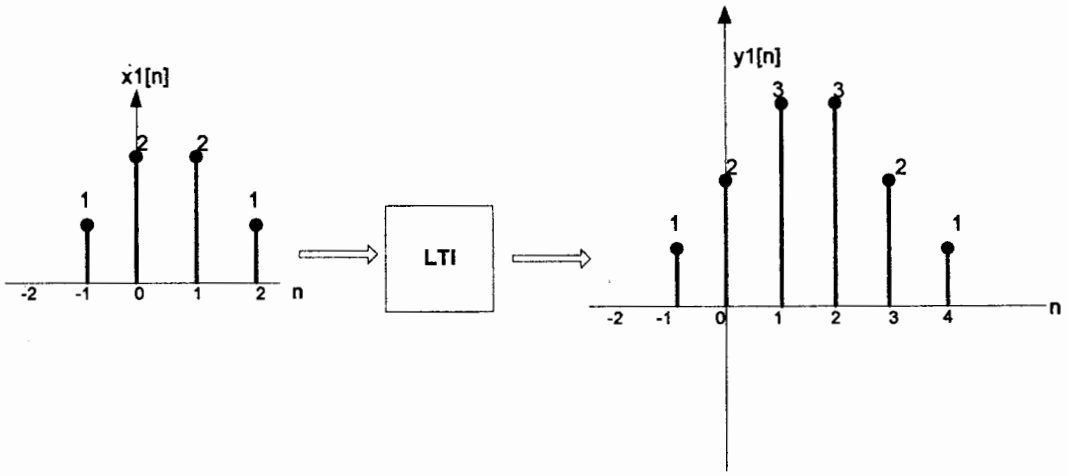


Figure 1 a)

a) Determine the difference equation explain the relationship between input and output. *(4 points)*
b) Determine the impulse response of this system *(1 point)*
c) Sketch the response of this system for input $x_2[n]$ in Figure 1 b) *(3 points)*

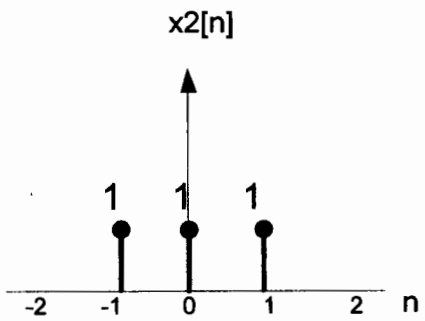


Figure 1b)

d) Is this system causal? *(2 points)*

2. Given a difference equation of an LTI system as:

$y[n-1] = \sum_{k=0}^{\infty} x[n-k-1]$
Determine: ***(10 points)***

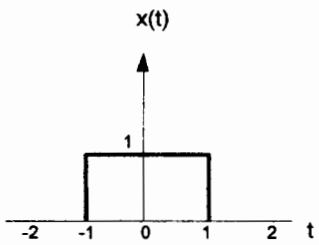
a) The impulse response of this system. *(3 points)*

b) The response of this system when the input is $x[n] = (\frac{1}{2})^n u[-n+1]$ *(4 points)*

c) Is this system a causal, dynamic, and stable? *(3 points)*

3. Determine the result of convolution ***(7 points)***

a) y(t)=x(t)*h(t) when x(t) and h represented in (t) are Figure 2 *(4 points)*



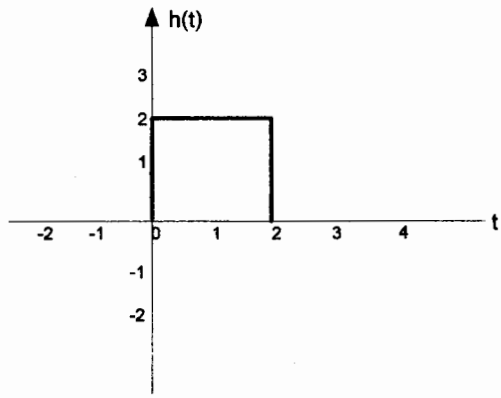


Figure 2

b) y[n]=x[n]*h[n] when
$x[n] = 2\delta[n+1] + \delta[n] - 0.5\delta[n-1]$ and $h[n] = \delta[n+1] + \delta[n-1]$
(3 points)

4. A linear system (S) has input-output pairs as shown in Figure 3.

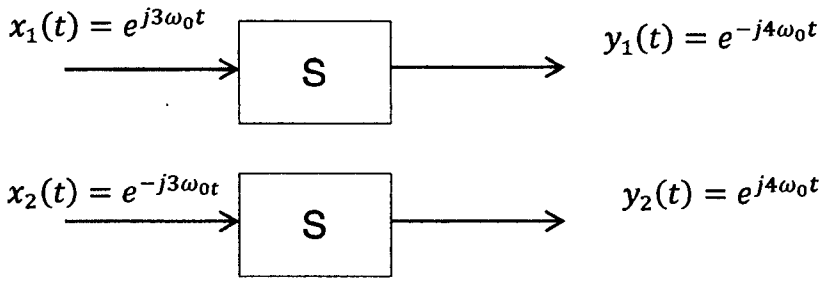


Figure 3

Determine the response of this system when the input is $x(t) = 2\cos(3\omega_0 t + \frac{\pi}{8})$

(5 points)

5. Determine the spectrum of the following signals: ***(4 points)***

a) $x(t) = \cos\left(\pi t + \frac{\pi}{3}\right) + \cos(\frac{\pi}{2}t + \frac{\pi}{6})$ *(2 points)*

b) $x(t) = 2 + \cos\left(\frac{\pi}{2}t\right) + \sin(\frac{\pi}{3}t + \pi)$ *(2 points)*

6. x(t) is real periodic signal with T=8, the non-zero FS coefficients for x(t) are:

$a_1 = a_{-1} = 2, \quad a_3 = a^*_{-3} = 4j$ what is x(t)? ***(4 points)***

$$x(t) = \sum_{k=-\infty}^{+\infty} a_k e^{jk\omega_0 t} = \sum_{k=-\infty}^{+\infty} a_k e^{jk(2\pi/T)t},$$

$$a_k = \frac{1}{T}\int_T x(t)e^{-jk\omega_0 t}\,dt = \frac{1}{T}\int_T x(t)e^{-jk(2\pi/T)t}\,dt.$$