

Hanoi Univ. of Science and Technology School of Electrical Engineering Dept. of Automatic Control	<b>EE2000 Signals and Systems</b> <b>Final Exam 20171 (2017-2018)</b> Time allowed: 90 min Date: 08/01/2018 <b>Exam No. 1</b>	Mark
Student name: Student ID: No.:	Signature of Marker:	Signature of Invigilator:

*Note: Students should write their solutions in these 3 pages. The students who write on page 4 will receive a 50% deduction grade. Only Homework Manual sealed by the Department and non-programmable calculators are allowed during the exam. (Students turn off their mobile. No correction pens or tapes are accepted).*

**PART A: CONTINUOUS-TIME SIGNALS AND SYSTEMS**

**Problem 1** (*System response*)

Consider a LTI causal system with the following transfer function:

$$H(s) = \frac{10}{s^2 + 10s + 100}$$

- a) (1pt) Sketch the system pole-zero diagram. Determine the values of  $\omega_n$  và  $\zeta$  . Is the system stable? Explain.

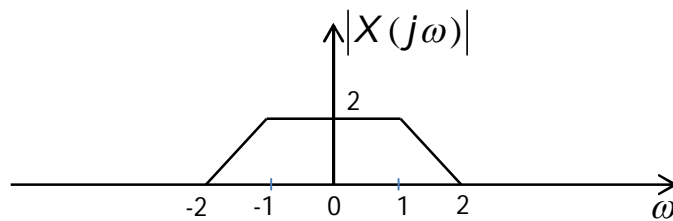
- b) (2pt) Calculate the step response  $s(t)$  of the system. Sketch  $s(t)$  .

- c) (1pt) From the eigenfunction of LTI systems, we know that with the input  $x(t) = e^{j\omega_0 t}$ , the output will be  $y(t) = H(j\omega_0)e^{j\omega_0 t}$  where  $H(j\omega)$  is the system frequency response. Determine the system steady-state response with the input  $x(t) = \cos(10t)u(t)$ . (Note:  $u(t)$  denotes the unit-step function).

**Problem 2 (Signal sampling)**

(2pt) Suppose during the sampling process, we obtain the signal  $x_s(t)$  from the signal  $x(t)$ . Note that  $x_s(t) = x(t)p(t)$  where  $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$  is the sampling function with the sampling period  $T = 2\pi/3$  sec.

Sketch the magnitude spectrum  $|X_s(j\omega)|$  of  $x_s(t)$  if the plot of the magnitude spectrum  $|X(j\omega)|$  of  $x(t)$  is shown in the following figure. Determine whether the aliasing occurs.



## PART B: DISCRETE-TIME SIGNALS AND SYSTEMS

### Problem 3 (*Discrete-time convolution*)

(2pt) Determine the convolution  $x[n]*v[n]$  where  $x[n]=u[n]$  and  $v[n]=2(0.8)^n u[n]$ . (*Note:  $u[n]$  denotes the discrete-time unit-step function*).

### Bài 4 (*The inverse Z transform*)

(2pt) Determine the impulse response  $h[n]$  of the causal system with the transfer function:

$$H(z) = \frac{z(z-1)}{z^2 - 0.5z - 0.5}$$

Sketch  $h[n]$  with the first 5 values of  $n$ .



Hanoi Univ. of Science and Technology School of Electrical Engineering Dept. of Automatic Control	<b>EE2000 Signals and Systems Final Exam 20171 (2017-2018)</b> Time allowed: 90 min Date: 08/01/2018 <b>Exam No. 2</b>	Mark
Student name: Student ID: No.:	Signature of Marker:	Signature of Invigilator:

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### **PART A: CONTINUOUS-TIME SIGNALS AND SYSTEMS**

#### **Problem 1** (*System response*)

Consider a LTI causal system with the following transfer function:

$$H(s) = \frac{1}{s^2 + 4s + 16}$$

- a) (1pt) Sketch the system pole-zero diagram. Determine the values of  $\omega_n$  và  $\zeta$  . Is the system stable? Explain.

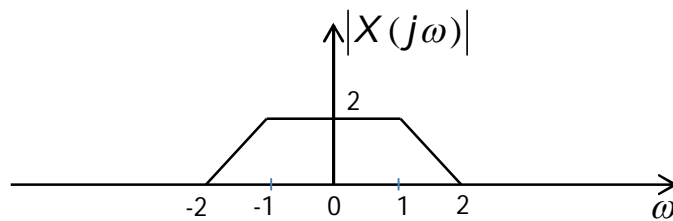
- b) (2pt) Calculate the step response  $s(t)$  of the system. Sketch  $s(t)$  .

- c) (1pt) From the eigenfunction of LTI systems, we know that with the input  $x(t) = e^{j\omega_0 t}$ , the output will be  $y(t) = H(j\omega_0)e^{j\omega_0 t}$  where  $H(j\omega)$  is the system frequency response. Determine the system steady-state response with the input  $x(t) = \sin(4t)u(t)$ . (Note:  $u(t)$  denotes the unit-step function).

**Problem 2 (Signal sampling)**

(2pt) Suppose during the sampling process, we obtain the signal  $x_s(t)$  from the signal  $x(t)$ . Note that  $x_s(t) = x(t)p(t)$  where  $p(t) = \sum_{n=-\infty}^{\infty} \delta(t - nT)$  is the sampling function with the sampling period  $T = \pi/4$  sec.

Sketch the magnitude spectrum  $|X_s(j\omega)|$  of  $x_s(t)$  if the plot of the magnitude spectrum  $|X(j\omega)|$  of  $x(t)$  is shown in the following figure. Determine whether the aliasing occurs.



## PART B: DISCRETE-TIME SIGNALS AND SYSTEMS

### Problem 3 (*Discrete-time convolution*)

(2pt) Determine the convolution  $x[n] * v[n]$  where  $x[n] = u[n-1]$  and  $v[n] = 2(0.5)^n u[n]$ . (Note:  $u[n]$  denotes the discrete-time unit-step function).

### Bài 4 (*The inverse Z transform*)

(2pt) Determine the impulse response  $h[n]$  of the causal system with the transfer function:

$$H(z) = \frac{z^2 + 1}{z^2 - 1.5z - 1}$$

Sketch  $h[n]$  with the first 5 values of  $n$ .

