

# 电子科技大学 2020 -2021 学年第 1 学期 期末考试 A 卷

考试科目: 信号与系统 考试形式: 一页纸开卷 考试日期: 2021 年 1 月 15 日

本试卷由 七 部分构成, 共 7 页。考试时长: 120 分钟

成绩构成比例: 平时成绩 50 %, 期末成绩 50 %

题号	一	二	三	四	五	六	七	合计
得分								

**Attention: Try to answer the following questions in English. All answers must be derived or explained, not just simply written down.**

得分

一、计算题 (12 分)

**Let**  $x_1[n] = \sin[\pi n / 2]$ ,  $x_2[n] = \cos[2n]$ ,  $x_3[n] = x_1[n+1] \cdot u[n]$ ,

$x_4[n] = x_1[n+1] \cdot \delta[n+2]$ .

- (a) Find the periodic signal(s) from  $x_1[n], x_2[n], x_3[n]$  and  $x_4[n]$ . Determine the fundamental period(s).
- (b) Determine and sketch  $x_3[n]$  and  $x_4[n]$ .
- (c) Determine and sketch the even and odd parts of  $x_3[n]$ .

得 分

二、计算题（12 分）

Consider the cascade of two LTI systems with the unit impulse responses  $h_1[n]$  and  $h_2[n]$  as shown in Figure 1, where  $h_1[n] = \cos[2n]$  and  $h_2[n] = a^n u[n]$ ,  $|a| < 1$ . For the given input  $x[n] = \delta[n] - a^2 \delta[n-2]$ , determine the output  $y[n]$ .



Figure 1.

得 分

三、计算题（16 分）

$x(t)$  is a band-limited signal satisfying  $X(j\omega) = 0, |\omega| > \omega_M$ . Determine the Nyquist rate  $\omega_s$  for each of the following signals:

(a)  $x\left(\frac{1}{2}t - 1\right)$

(b)  $x(t) + x^*(-t)$

(c)  $3x^2(t)$

(d)  $x(t)\cos(\omega_M t)$

得 分

四、计算题（12 分）

Let  $X(j\omega)$  denote the Fourier transform of the input signal  $x(t)$  of system S and  $Y(j\omega)$  denote the Fourier transform of the output signal  $y(t)$  of system S, as shown in Figure 2. Construct the system S with three components. Two of them are filters with  $h_1(t) = \frac{2 \sin 3\pi t}{\pi t}$  and  $h_2(t) = \frac{2 \sin 9\pi t}{\pi t}$ . The third component is a modulator shown in Figure 3. Note that you can specify  $\omega_c$  to fulfill the function of system S.

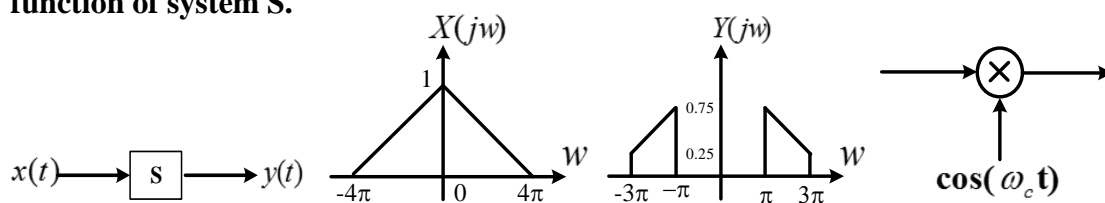


Figure 2

Figure 3

得 分

五、 计算题（16 分）

Assume  $x_1(t) = t[u(t+1) - u(t-1)]$  and  $x_2(t) = \sum_{k=-\infty}^{+\infty} x_1(t-4k)$ . If  $x_2(t)$  is input into an LTI system with impulse response  $h(t) = \frac{\sin t \cos 2t}{\pi t}$ , determine the system response.

得 分

六、计算题（16 分）

The block-diagram of a causal continuous-time LTI system whose unit impulse response  $h(t)$  has the initial value  $h(0^+) = 3$ , is given in Figure 4, where  $K$  is an unknown constant.

- (a) Determine the system function  $H(s)$  and its ROC, is the system stable?
- (b) Determine  $h(t)$ .
- (c) Determine the output  $y(t)$  when the input  $x(t) = 1$ .

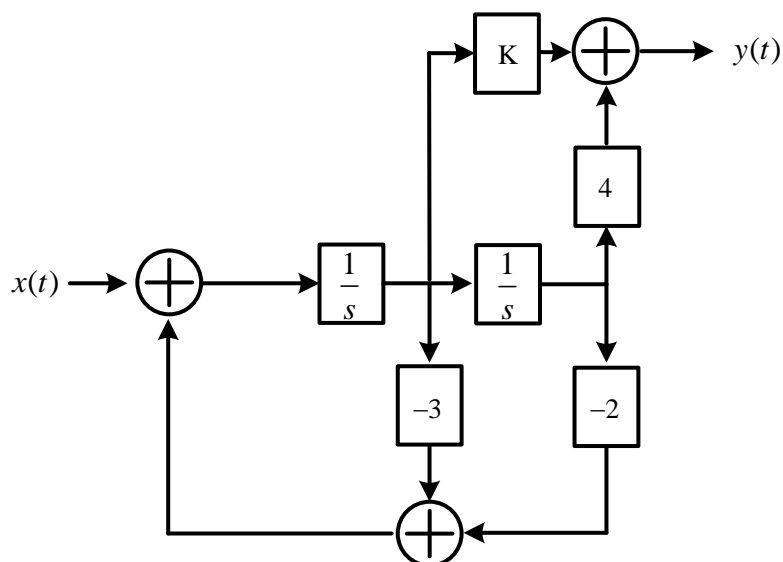


Figure 4

得 分

七、计算题（16 分）

For a discrete-time LTI system, the output is  $y_1[n] = -\frac{2}{3}(-2)^n u[-n-1] + \frac{1}{3}u[n]$  when the input is  $x_1[n] = u[n] + Lu[n-1]$ , where  $L$  is an unknown constant. The output becomes  $y_2[n] = \frac{2}{3}(-1)^{n+1}$ , when the input is  $x_2[n] = \cos[\pi n]$ .

- (a) Determine the system function  $H(z)$  and its ROC.
- (b) Is the system stable and/or causal?
- (c) Determine the unit impulse response  $h[n]$ .