

**Department of Electrical and Computer Engineering
Stony Brook University**

ESE 305/EEO 301 Signals and Systems (Summer 2024)

Homework 2

Due Date: June 2, 2024 (11:59PM via Brightspace in single PDF file.)

This assignment is to be done individually.

Problem 1: Chapter 1, Problem 26

- 1.26** Which of $\sin 6.8\pi n$, $\cos 0.2n$, $\sin 4.9n$, $\sin 1.6\pi n$, and $-\sin 1.1n$ are periodic sequences? If they are, find their fundamental periods in samples. Are their frequencies defined without specifying the sampling period?

Problem 2: Chapter 1, Problem 32

- 1.32** Consider the CT sinusoid $x(t) = \sin 4t$. What are the frequencies of its sampled sequences if the sampling period T are 0.3, 0.6, 0.9, and 1.2? Do they equal the frequency of $\sin 4t$? Under what condition on T will the frequency of $\sin 4nT$ equal 4 rad/s?

Problem 3: Chapter 2, Problem 1

- 2.1** Consider a CT LTI system. Let y_i be the output excited by the input u_i and initial state $\mathbf{x}_i(0)$, for $i = 1, 2, 3$. If $\mathbf{x}_1(0) = \mathbf{x}_2(0) = \mathbf{x}_3(0) = \mathbf{a} \neq \mathbf{0}$, which of the following statements are correct?
- (a) If $u_3 = u_1 + u_2$, then $y_3 = y_1 + y_2$.
 - (b) If $u_3 = 0.5(u_1 + u_2)$, then $y_3 = 0.5(y_1 + y_2)$.
 - (c) If $u_3 = u_1 - u_2$, then $y_3 = y_1 - y_2$.

Problem 4: Chapter 2, Problem 5

- 2.5** Discuss whether or not each of the following equations is memoryless, linear, time-invariant, and causal:
- (a) $y(t) = -2 + 3u(t)$
 - (b) $y(t) = \sqrt{u(t)}$
 - (c) $y(t) = u(t)u(t-1)$
 - (d) $y(t) = tu(t)$
 - (e) $y(t) = \int_{t_0}^t u(\tau) d\tau + y(t_0)$
 - (f) $y(t) = \int_{t_0}^t \tau u(\tau) d\tau + y(t_0)$

Problem 5: Chapter 2, Problem 7

- 2.7** Consider a CT linear system. Its zero-state responses excited by u_1 and u_2 are shown in Figure 2.25(a). Is the system time-varying or time-invariant? Can you find the zero-state responses excited by the inputs u_3 , u_4 , and u_5 shown in Figure 2.25(b)?

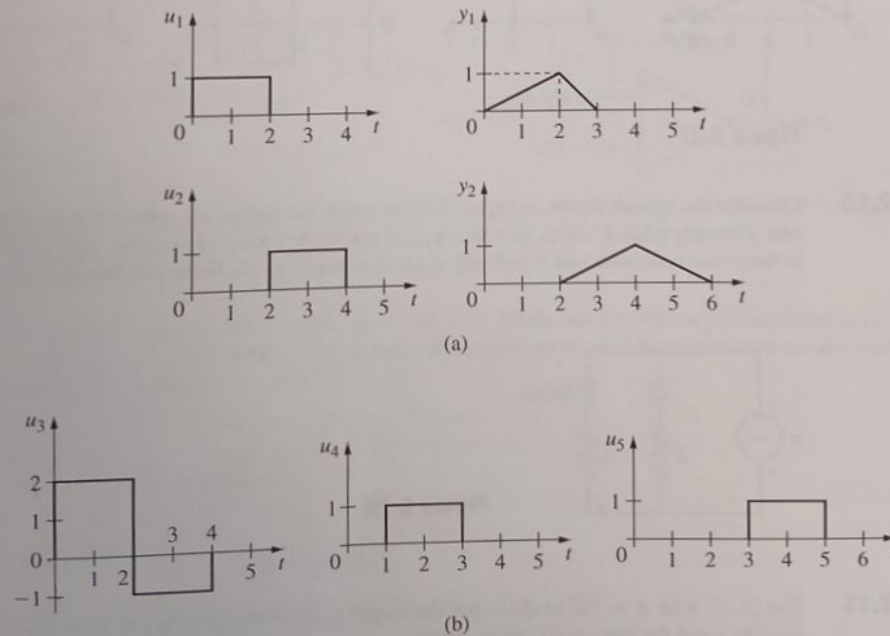


Figure 2.25

Problem 6: Chapter 2, Problem 8

- 2.8** Consider a CT LTI system. Given the input and output pair in Figures 2.26(a) and 2.26(b). Find the output excited by the input shown in Figure 2.26(c).

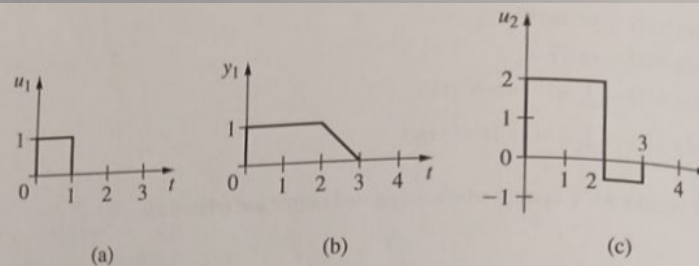


Figure 2.26

Problem 7: Chapter 2, Problem 9

2.9 Consider a CT LTI system. Suppose its step response (the zero-state response excited by a step input or $u(t) = q(t)$) is as shown in Figure 2.27(a). Find the outputs excited by the inputs shown in Figures 2.27(b) through 2.27(d).

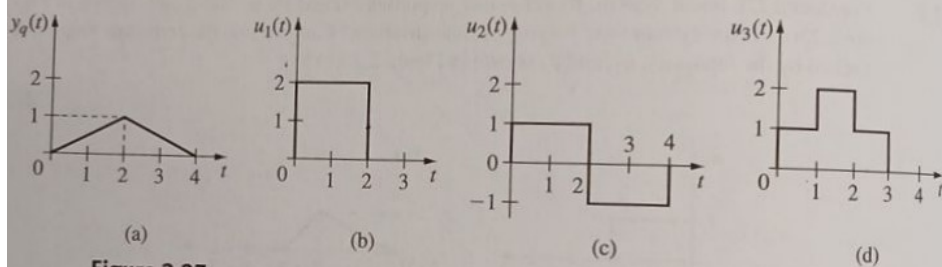


Figure 2.27