Capital University of Science and Technology
Department of Electrical and Computer Engineering

CPE2613: Signals and Systems (Section-1), Fall-2026
Assignment No. 1

Instructor: Mr. Abdullah Numani **Date:** 11/10/2026

Total Marks: 10 **Due Date:** 16/10/2026

Instructions:

- **Assignment submission should be Handwritten and on A4 size sheet.**
- **Late submission is not allowed.**
- **Attempt all questions**
- **Copied Assignment will get zero credit.**
- **Avoid unnecessary details and arguments.**

Name: _____ **Reg. No.** _____

CLO-1

Question No. 1:

Explain the odd and even signals in both continuous time and discrete time. Classify the following signals as even, odd, or neither even nor odd. Consider both continuous-time and discrete-time signals.

(a) Continuous-time signals

1. $x(t) = t^2$
2. $x(t) = t^3$
3. $x(t) = e^t$
4. $x(t) = \cos(3t)$
5. $x(t) = \sin(2t)$

(b) Discrete-time signals

1. $x[n] = n^2$
2. $x[n] = n^3$
3. $x[n] = (0.5)^n$
4. $x[n] = \cos\left(\frac{\pi n}{2}\right)$
5. $x[n] = \sin\left(\frac{\pi n}{3}\right)$

Question No. 2:

Explain the periodic and non-periodic signals in both continuous and discrete time. Classify the following signals as periodic or non-periodic. For each periodic signal, determine its fundamental period.

(c) Continuous-time signals

1. $x(t) = \cos(4\pi t)$
2. $x(t) = \sin(3t)$
3. $x(t) = e^{-2t}$
4. $x(t) = \cos(2\pi t) + \sin(4\pi t)$
5. $x(t) = \cos(\sqrt{2}\, t)$

(d) Discrete-time signals

1. $x[n] = \cos\left(\frac{\pi n}{4}\right)$
2. $x[n] = \sin\left(\frac{2\pi n}{5}\right)$
3. $x[n] = (0.5)^n$
4. $x[n] = \cos\left(\frac{\pi n}{3}\right) + \sin\left(\frac{\pi n}{2}\right)$
5. $x[n] = \cos(n)$

Question No. 3:

Discuss the time shifting operation of signals in detail. Consider the following continuous-time signal:

$$x(t) = \begin{cases} t+2, & -2 \le t < 0 \\ 2, & 0 \le t < 2 \\ 4-t, & 2 \le t \le 4 \\ 0, & \text{otherwise} \end{cases}$$

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and signal amplitudes.
(b) Sketch the time-delayed signal $y_1(t) = x(t-2)$.
(c) Sketch the time-advanced signal $y_2(t) = x(t+3)$.
(d) Sketch the time-reversed signal $y_3(t) = x(-t)$.
(e) Sketch the time-reversed and shifted signal $y_4(t) = x(2-t)$.

Question No. 4:

Discuss the time compression and expansion operation of signals in detail. Consider the following continuous-time signal:

$$x(t) = \begin{cases} 2, & -3 \le t < -1 \\ t+3, & -1 \le t < 1 \\ 4-t, & 1 \le t \le 3 \\ 0, & \text{otherwise} \end{cases}$$

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and amplitudes.
(b) Sketch the time-compressed signal $y_1(t) = x(1.5t)$.
(c) Sketch the time-expanded signal $y_2(t) = x\left(\frac{t}{3}\right)$.

Question No. 5:

Consider the following continuous-time signal:

$$x(t) = \begin{cases} t+1, & -2 \le t < 0 \\ 1-t, & 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$$

For the given signal, perform the following operations:

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and amplitudes.
(b) Sketch the transformed signal $y_1(t) = x(2t-2)$.
(c) Sketch the transformed signal $y_2(t) = x\left(\frac{t}{2}+1\right)$.
(d) Sketch the transformed signal $y_3(t) = x(-2t+2)$.
(e) Sketch the transformed signal $y_4(t) = x\left(-\frac{t}{2}-1\right)$.
(f) For each transformed signal, determine the new time intervals and write its piecewise mathematical expression.
(g) Identify whether each operation involves time compression or expansion, time shifting, and time reversal, where applicable.

Question No. 6:

Explain the amplitude scaling operation of signals in continuous and discrete time signals.

Consider the following continuous-time signal:

$$x(t) = \begin{cases} 2t + 4, & -2 \le t < 0 \\ 4 - 2t, & 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$$

(a) Sketch the original signal $x(t)$, indicating all breakpoints and amplitudes.

(b) Sketch the amplitude-scaled signal $y_1(t) = 2x(t)$.

(c) Sketch the amplitude-scaled signal $y_2(t) = \frac{1}{2}x(t)$.

(d) Sketch the amplitude-inverted signal $y_3(t) = -x(t)$.

(e) Sketch the signal $y_4(t) = -3x(t)$.

(f) Write the mathematical piecewise expression for each transformed signal.

Question No. 7:

Explain the amplitude shifting operation of signals in continuous and discrete time signals.

Consider the following continuous-time signal:

$$x(t) = \begin{cases} t + 3, & -2 \le t < 0 \\ -2 - t, & 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$$

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and amplitudes.

(b) Sketch the amplitude shifted signal $y_1(t) = x(t) + 3$.

(c) Sketch the amplitude shifted signal $y_2(t) = x(t) - 2$.

(d) Write the mathematical piecewise expression for each transformed signal.

Question No. 8:

Consider the following continuous-time signal:

$$x(t) = \begin{cases} t - 3, & -2 \le t < 0 \\ -1 + t, & 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$$

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and amplitudes.

(b) Sketch the transformed signal $y_1(t) = 2x(t) + 3$.

(c) Sketch the transformed signal $y_2(t) = \frac{1}{2}x(t) - 2$.

(d) Sketch the transformed signal $y_3(t) = -\frac{1}{3}x(t) + 1$.

(e) Sketch the transformed signal $y_4(t) = -2x(t) - 1$.

(f) Write the piecewise mathematical expression for each transformed signal.

Question No. 9:

Consider the following continuous-time signal:

$$x(t) = \begin{cases} t+3, & -3 \le t < -1 \\ 2, & -1 \le t < 1 \\ 3-t, & 1 \le t \le 3 \\ 0, & otherwise \end{cases}$$

(a) Sketch the original signal $x(t)$, clearly indicating all breakpoints and amplitudes.

(b) Sketch the transformed signal

$$y_1(t) = 2x(2t-2) + 1$$

(c) Sketch the transformed signal

$$y_2(t) = -3x\left(\frac{t}{2} + 1\right) + 2$$

(d) Sketch the transformed signal

$$y_3(t) = -2x(-t+2) - 1$$

(e) For each transformed signal, determine the new time intervals and write its piecewise mathematical expression.

(f) Identify the operations involved in each transformation: time shifting, time compression or expansion, time reversal, amplitude scaling, amplitude shifting, and amplitude reversal.

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