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

CPE2613: Signals and Systems (Section-1), Fall-2026
Assignment No. 2

Instructor:	Mr. Abdullah Numani	**Date:**	10/11/2026
Total Marks:	10	**Due Date:**	16/11/2026

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.**
- **Support every answer by applying the relevant definition; a bare yes/no gets no credit.**

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

CLO-2

Question No. 1:

(a) For the real sinusoid $x(t) = 5\cos\left(4t + \frac{\pi}{3}\right)$, **determine** the amplitude, phase, fundamental frequency and fundamental period, and **compute** $x(0)$.

(b) **Calculate** the fundamental period of $x(t) = 2\sin\left(6\pi t - \frac{\pi}{4}\right)$.

(c) For the real exponential $x(t) = 3e^{\lambda t}$, **compute** $x(0)$ and $x(1)$ for $\lambda = -2$, $\lambda = 0$ and $\lambda = 2$, and **sketch** $x(t)$ for each case on separate axes.

Question No. 2:

Apply the definitions of memory and causality to **determine** whether each of the following continuous-time systems is (i) memoryless or with memory, and (ii) causal or noncausal.

(a) $y(t) = 3x(t) + 2$

(b) $y(t) = x(t - 2)$

(c) $y(t) = x(t + 1)$

(d) $y(t) = x(t)\cos(5t)$

(e) $y(t) = x(t - 1) + x(t + 1)$

Question No. 3:

Consider the complex sinusoid

$$x(t) = 3e^{\,j(20t+\pi/4)}.$$

(a) **Use** Euler's relation to **determine** $\mathrm{Re}\{x(t)\}$ and $\mathrm{Im}\{x(t)\}$.

(b) **Compute** $x(0)$ in rectangular form, and **determine** the fundamental period and fundamental frequency of $x(t)$.

(c) **Sketch** $\mathrm{Re}\{x(t)\}$ and $\mathrm{Im}\{x(t)\}$ over one period, indicating the amplitude and the values at $t = 0$, and **show** that the two graphs differ only by a time shift.

Question No. 4:

(a) **Use** Euler's identities to express each of the following real sinusoids as a sum of two complex sinusoids:

$$x_1(t) = 8\cos\left(50t - \frac{\pi}{3}\right), \qquad x_2(t) = 4\sin\left(50t + \frac{\pi}{6}\right).$$

(b) For the general complex exponential $x(t) = 2e^{(-3+j4)t}$, **determine** σ and ω, **use** Euler's relation to write $\mathrm{Re}\{x(t)\}$ and $\mathrm{Im}\{x(t)\}$, and **determine** which mode of behaviour (growing, constant amplitude or decaying) $x(t)$ exhibits.

(c) **Sketch** $\mathrm{Re}\{x(t)\}$ from part (b) for $t \geq 0$, showing its exponential envelope.

Question No. 5:

Apply the definitions of additivity, homogeneity and time invariance to **determine** whether each of the following systems is (i) linear and (ii) time invariant. **Show** every step of each test.

(a) $y(t) = 5x(t)$

(b) $y(t) = x(t) + 3$

(c) $y(t) = t\,x(t)$

(d) $y(t) = x^2(t)$

(e) $y(t) = x(-t)$

Question No. 6:

(a) **Determine** whether each of the following systems is invertible. If it is invertible, **determine** its inverse system; if it is not, **show** two distinct inputs that produce identical outputs.

$$\text{(i)}\ \ y(t) = 4x(t) - 3, \qquad \text{(ii)}\ \ y(t) = x^2(t), \qquad \text{(iii)}\ \ y(t) = x(t-2).$$

(b) **Determine** whether each of the following systems is BIBO stable. If it is stable, **show** that every bounded input gives a bounded output; if it is not, **use** a single bounded input that gives an unbounded output.

$$\text{(i)}\ \ y(t) = e^{x(t)}, \qquad \text{(ii)}\ \ y(t) = t\,x(t), \qquad \text{(iii)}\ \ y(t) = \int_{-\infty}^{t} x(\tau)\,d\tau.$$

Question No. 7:

Consider the two continuous-time systems

$$\mathcal{H}_1: \quad y_1(t) = x(t-2), \qquad\qquad \mathcal{H}_2: \quad y_2(t) = t\,x(t).$$

(a) **Sketch** the block diagram of the series connection $\mathcal{H}_1$ followed by $\mathcal{H}_2$, and **determine** the overall output $y(t) = \mathcal{H}_2\{\mathcal{H}_1\{x\}\}$ in terms of x.

(b) **Determine** the overall output when the order is reversed ($\mathcal{H}_2$ followed by $\mathcal{H}_1$), and **show** that the two series connections are not equivalent.

(c) **Sketch** the block diagram of the parallel connection of $\mathcal{H}_1$ and $\mathcal{H}_2$, **determine** its overall output, and **determine** whether the overall parallel system is memoryless, causal, linear and time invariant.

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