Exercise 1. Consider the following discrete-time signal

\[ x[n] = \cos (2\pi^2 n) \]

A) Determine whether or not \( x[n] \) is periodic. If it is, determine its fundamental period [pt. 10].

Exercise 2. Consider the continuous-time signal

\[ x(t) = \begin{cases} 
3 - t & 0 \leq t \leq 3 \\
0 & \text{otherwise}
\end{cases} \]

A) Sketch and label carefully \( x(3 - 2t) \) [pt. 10].

Exercise 3. A continuous-time LTI system has impulse response

\[ h(t) = e^{ct} u(-t) \quad 0 < c < 1 \]

where \( u(t) \) is the causal step function.

A) Determine whether or not the system is [pt. 10]:

- memoryless
- causal
- stable

Exercise 4. Consider the signal

\[ x(t) = e^{ct} u(-t) \quad 0 < c < 1 \]

where \( u(-t) \) is the causal step function.

A) Derive the energy and the time-averaged power of the signal over \(-\infty < t < \infty\) [pt. 10].

Exercise 5. Consider the discrete-time LTI system with impulse response

\[ h[n] = \begin{cases} 
2 & n = 0, 1, 2, 3 \\
0 & \text{otherwise}
\end{cases} \]

The signal at the system input is

\[ x[n] = u[n] + \delta[n + 1] \]

where \( u[n] \) is the causal step function.
A) Derive the expression of the signal at the output of the system. Sketch the output signal [pt. 20].

**Exercise 6.** Consider the LTI system with the following input (x) output (y) relation

\[ y(t) = \int_{-\infty}^{t+15} 2 \cdot x(\tau) \, d\tau \]

A) Calculate the impulse response of the system and determine whether or not the system is causal [pt. 18].

**Exercise 7.** Consider the continuous-time LTI system shown in Fig. 1, where the impulse responses of the

\[ x(t) \rightarrow h_1(t) \rightarrow y(t) \]

\[ h_2(t) \rightarrow + \rightarrow y(t) \]

Figure 1: Parallel of two LTI subsystems.

two subsystems are shown in Fig. 2.

A) Sketch and label carefully the response of the system \( y(t) \) to the input [pt. 22]

\[ x(t) = \sum_{k=-\infty}^{+\infty} \delta(t - 2kT) \]