1. [10] Define the linear system. Give an <u>example</u> and a <u>counter-example</u> (反例)and then explain them.

2. [10] Define the time-invariant system. Give an <u>example</u> and a <u>counter-example</u>(反例) and then explain them.

3. [10] Define the linear-time-invariant system. What is the advantage of this system in applications?

4. [10] Fourier Transform
   A. [5] Compute the Fourier transform of the signal $\sin(10t + 1)$.
   B. [5] Draw the spectrum for the above signal too.

5. [10] Prove and explain the sampling theorem on signals. Please give an example.

6. [20] Discrete-Time Fourier Transform
   A. [5] Find the Fourier transform of the signal $x_1[n] = \dfrac{1}{3^n}u[n]$.

   B. [5] Using the result of A, find the Fourier transform of $x_2[n] = \dfrac{1}{3^n}u[n+3]$.

   C. [10] Using the result of A, find the Fourier transform of $x_3[n] = \dfrac{1}{3^{|n|}}$.

7. [30] Consider a continuous-time system $y(t) = x(t-2) + x(1-2t)$ with the input signal:
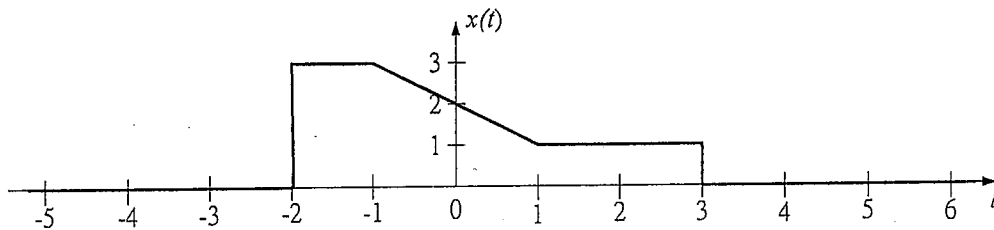
Please answer the following questions.
   A. [10] Determine whether or not the system is <u>memoryless</u>, <u>causal</u>, or <u>stable</u>. Please explain your reasons.
   B. [10] Decompose the input signal $x(t)$ as an even signal and an odd signal. That is, $x(t) = x_e(t) + x_o(t)$, where $x_e(t)$ is even and $x_o(t)$ is odd. Sketch $x_e(t)$ and $x_o(t)$ respectively.
   C. [10] Sketch the output signal $y(t)$.