淡江大學九十學年度碩士班招生考試試題

系別：電機工程學系　　科目：通 信 系 統

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本試題共 2 頁

1. (20) The total energy of a continuous signal $x(t)$ is defined as

$$E = \lim_{T\to\infty}\int_{-T/2}^{T/2} x^2(t)\,dt = \int_{-\infty}^{\infty} x^2(t)\,dt.$$

While the average power of $x(t)$ is defined as

$$P = \lim_{T\to\infty}\frac{1}{T}\int_{-T/2}^{T/2} x^2(t)\,dt.$$

Then a signal is referred to as an energy signal if and only if $0 < E < \infty$. On the other hand, it is referred to as a power signal if and only if $0 < P < \infty$.

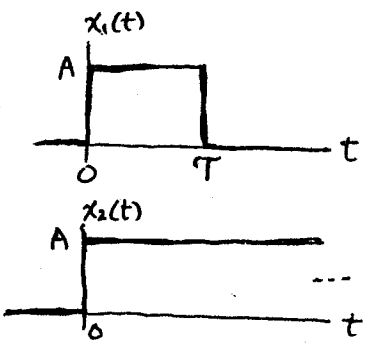

Fig. 1

Now, refer to Fig. 1.

(a) Find E and P for $x_1(t)$.

(b) Find E and P for $x_2(t)$.

(c) Is $x_1(t)$ an energy signal or a power signal?

(d) Is $x_2(t)$ an energy signal or a power signal?

2. (20) A system is said to be linear if it satisfies the following: If input $x_1(t)$ produces output $y_1(t)$ and input $x_2(t)$ produces out $y_2(t)$, then input $x(t) = ax_1(t) + bx_2(t)$ will produce output $y(t) = ay_1(t) + by_2(t)$, where a and b are constants. Determine whether

(a) $h_1(t)$ is linear,

(b) $h_2(t)$ is linear, and

(c) $h_3(t)$ is linear.

[Note: You must perform calculations to support your answers.]

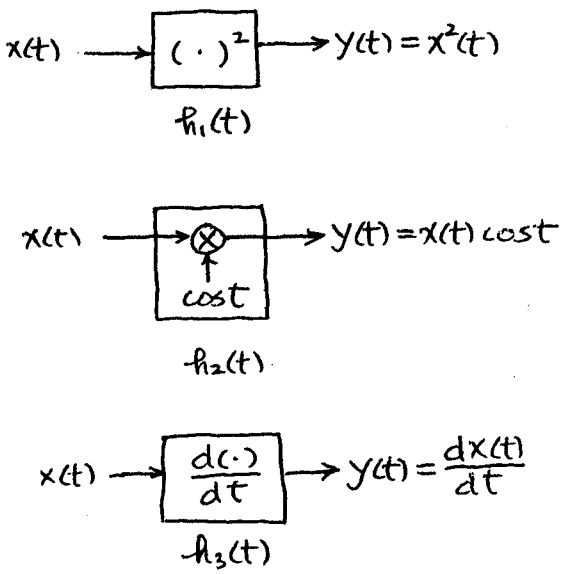

Fig. 2

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3. (20) A system is said to be time-invariant if it satisfies the following: If input $x(t)$ produces output $y(t)$, then input $x(t-t_0)$ produces $y(t-t_0)$, where t_0 is a time delay. Again, refer to Fig. 2. Determine whether
   (a) $h_1(t)$ is time-invariant,
   (b) $h_2(t)$ is time-invariant, and
   (c) $h_3(t)$ is time-invariant.
   [Note: You must perform calculations to support your answers.]

4. (20) Suppose an energy signal $x(t)$ has its Fourier transform $X(f)$. Parseval's relation states that

$$\int_{-\infty}^{\infty} x^2(t)\,dt = \int_{-\infty}^{\infty} |X(f)|^2 df.$$

   Now use Parseval's relation to find the integral

$$\int_{-\infty}^{\infty} \frac{\sin^2 u}{u^2}\,du.$$

5. (20) An analog signal is given by

$$x(t) = \sin(2\pi t)\cdot\cos(10\pi t)$$

   This signal is sampled with sampling interval T. Apply Sampling theorem to determine the bound on T to guarantee that the original analog signal could be recovered from the sampled version without loss of information.
   [Hint: $\sin A\cos B = \frac{1}{2}\sin(A+B) + \frac{1}{2}\sin(A-B)$].