國立雲林科技大學
101 學年度碩士班暨碩士在職專班招生考試試題

系所：電機系
科目：信號與系統

There are totally 7 questions, totally 100 points. Please answer the following questions in order, otherwise no score will be considered.

1. Determine the fundamental period of the signals below:
   (a) (3%) Determine the fundamental period of the signal $2\sin(3t+2)$?
   (b) (3%) Determine the fundamental period of the signal $3\cos(4t+3)$?
   (c) (4%) Determine the fundamental period of the signal $[2\sin(3t+2)-3\cos(4t+3)]$?

2. Consider the feedback system as Figure 1. Assume that $y[n]=0$ for $n<0$:
   (a) (5%) Sketch the function of the output $y[n]$ when $x[n]=\delta[n]$?
   (b) (5%) Sketch the function of the output $y[n]$ when $x[n]=u[n]$?

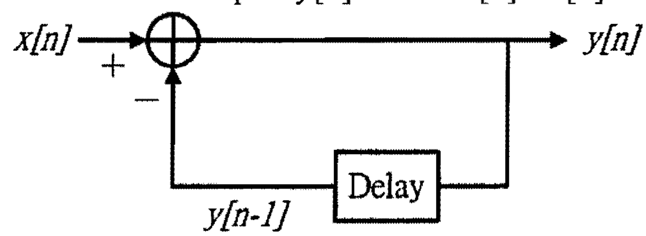


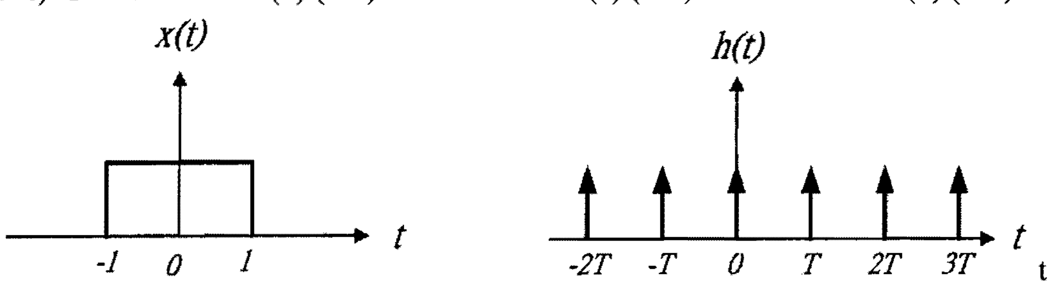
Figure 1

3. Let $x(t)$ be the rectangular pulse shown in Figure 2(a), and let $h(t)$ be the impulse train depicted in Figure 2(b). That is

$$h(t)=\sum_{k=-\infty}^{\infty}\delta(t-kT)$$

Determine and sketch $y(t)=x(t)*h(t)$ when T is equal to the following value:

(a) (5%) T =4? (b) (5%) T =2? (c) (5%) T =3/2? (d) (5%) T =1?



(a) (b)

Figure 2

4. Let $x(t)$ be a periodic signal with fundamental period T and Fourier series coefficients a_k. That is, $a_k=\frac{1}{T}\int_T x(t)e^{-jk(2\pi/T)t}dt$ and $x(t)=\sum_{k=-\infty}^{\infty}a_k e^{jk(2\pi/T)t}$. Please derive the Fourier series coefficients of the following signals in terms of a_k:

   (a) (5%) $x(5t-t_0)$? (b) (5%) $\frac{d^2x(t)}{dt^2}$?

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5. (16%) AM Modulation. Given a voice signal s(t) whose Fourier Transform (spectrum) $S(\omega)=10$ between the range $(-\omega_1, \omega_1)$ and $S(\omega)=0$ otherwise. Let $p(t)=\cos\omega_0 t$ be the modulation signal, assume $\omega_0 >> \omega_m$

(a) Sketch $S(\omega)$.

(b) Sketch $P(\omega)$, the Fourier Transform of p(t) (Hint: $P(\omega)=\pi\delta(\omega-\omega_0)+\pi\delta(\omega+\omega_0)$)

(c) The transmitted signal r(t)=s(t)p(t), find and sketch $R(\omega)$, the Fourier Transform of r(t).

(d) The demodulated signal g(t)=r(t)p(t), find and sketch $G(\omega)$, the Fourier Transform of g(t). How to recover s(t) from g(t)?

(Hint: Multiplication in time domain corresponds to convolution in the frequency domain)

6. (16%) Digitization is the process to obtain a discrete time signal x[n] from a continuous time signal x(t).

(a) Name the two major steps in digitization.

(b) Why do digital processing of continuous time signals become standard in most applications?

(c) Given a signal x(t) with non-zero frequency contents between $(-2\pi\cdot 4000, 2\pi\cdot 4000)$. Accordingly to the sampling theorem, what is the minimal sampling period T so that x(t) can be reconstructed from x[n] without aliasing?

7. (18%) Aliasing as Figure 3

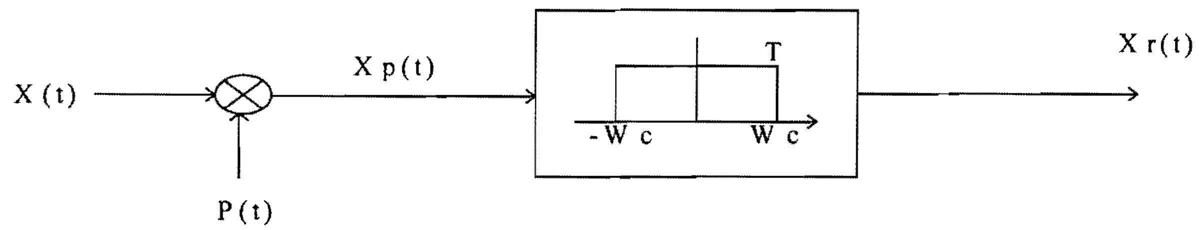

Figure 3

where:

$$\begin{cases} X(t)=\cos\omega_0 t, \quad \textit{Sampling function} \quad P(t)=\sum_{k=-\infty}^{k=+\infty}\delta(t-kT) \\ Xp(t)=X(t)P(t), \quad \omega_C=\frac{\omega_S}{2}, \quad \omega_S=\frac{2\pi}{T}=400 \end{cases}$$

Find $X_r(t)$ for each ω_o given below **(explain the reasons, no score if guessing)**

(a) $\omega_o=100$ (b) $\omega_o=150$ (c) $\omega_o=300$ (d) $\omega_o=400$ (e) $\omega_o=500$