淡江大學八十七學年度碩士班入學考試試題

系別： 電機工程學系　　科目： 通信系統

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1. Shows that the Fourier Transform of the nonperiodic rectangular pulse has the same form as the envelope of the Fourier series representation of the periodic rectangular, where the periodic square wave is defined over one period as $x(t) = \begin{cases} 1, & |t| < T_1 \\ 0, & T_1 < |t| < \frac{T}{2} \end{cases}$ and fundamental period is T. (20%)

2. (a) For continuous-time system, the input and output are related through a linear constant-coefficient differential equation which is given by $\sum_{k=0}^{N} a_k \frac{d^k y(t)}{dt^k} = \sum_{k=0}^{M} b_k \frac{d^k x(t)}{dt^k}$ ... (1), under what condition, the system described by (1) is causal, linear and time-invariant. (35%)

(b) (i) Consider a first-order differential equation is given as $\frac{dy(t)}{dt} + 2y(t) = x(t)$, $x(t) = Ke^{3t}u(t)$, K: constant. $u(t)$: unit step function. (5%)

show that under the condition in (a), the system is linear and time-invariant. (10%)

(ii) If this system in (i) satisfies the auxiliary condition $y(0) = 0$, shows that the system is not causal (Hint: use an approach with $x_1(t) = 0$ for all t and $x_2(t) = \begin{cases} 0, & t < -1 \\ 1, & t > -1 \end{cases}$) and under what condition the system is causal. (20%)

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(20%) 3. (i) A class of popularly used pulses in PAM are those which have a raised cosine frequency response. The frequency response of one of the members of this class is $P(j\omega) = \begin{cases} \frac{1}{2}\left(1+\cos\frac{\omega T_1}{2}\right), & 0 \le |\omega| \le \frac{2\pi}{T_1} \\ 0, & \text{elsewhere} \end{cases}$

where T_1 is the intersymbol spacing.

(10%) (a) Determine $p(0)$, (b) Determine $p(KT_1)$, where $K = \pm 1, \pm 2, \cdots$

(10%) (ii) Suppose $x[n]$ is a real-valued discrete-time signal whose Fourier transform $X(e^{j\omega})$ has the property that $X(e^{j\omega}) = 0$ for $\frac{\pi}{8} \le \omega \le \pi$. We use $x[n]$ to modulate a sinusoidal carrier $c[n] = \sin(\frac{5\pi}{2})n$ to produce $y[n] = x[n]\,c[n]$. Determine the value of ω in the range $0 \le \omega \le \pi$ for which $Y(e^{j\omega})$ is guaranteed to be zero.

(25%) 4. Amplitude modulation with a pulse-train carrier may be modeled as in Fig. 1(a). The output of the system is $g(t)$

(15%) (a) Let $x(t)$ be a band-limited signal [i.e. $X(j\omega) = 0, |\omega| \ge \frac{\pi}{T}$], as shown in Fig. 1(b). Determine and sketch $R(j\omega)$ and $Q(j\omega)$

(15%) (b) Find the maximum value of Δ such that $w(t) = x(t)$ with an appropriate filter $M(j\omega)$

(5%) (c) Determine and sketch the compensating filter $M(j\omega)$ such that $w(t) = x(t)$

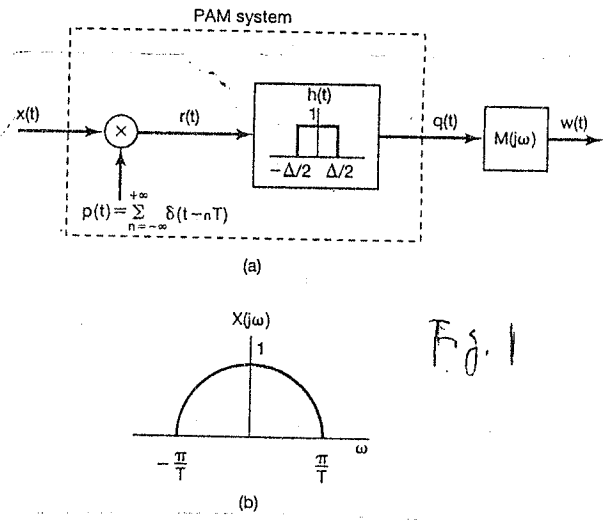

Fig. 1