國 立 臺 北 科 技 大 學

九十九學年第二學期電機系博士班資格考試

通訊系統(大學部) 試題

注意事項：

1. 本試題共【4】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在試卷答案欄內，否則不予計分。
4. 考試時間:二小時。

1.Given a filter with frequency response function

$$H(f)=\frac{5}{4+j(2\pi f)}$$

and input $x(t)=e^{-3t}u(t)$, obtain and plot the energy spectral density for

(10%) (a) the input signal $x(t)$

(15%) (b) the output signal, if $x(t)$ is the input to the filter

2. In a digital communication system, a root-raised cosine (RRC) filter is frequently used as the transmit and receiver filter. A RRC filter $H_{RRC}(f)$ is defined as

$$H_{RC}(f) = H_{RRC}(f)H_{RRC}(f),$$

where

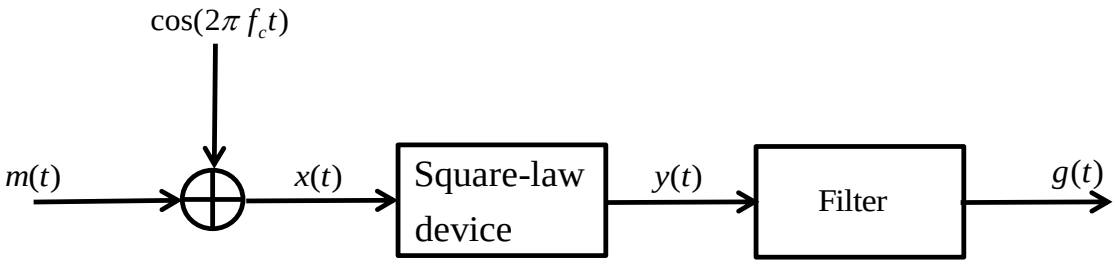
$$H_{RC}(f) = \begin{cases} T, & 0 \le |f| \le \dfrac{1-\alpha}{2T} \\ \dfrac{T}{2}\left[1+\cos\dfrac{\pi T}{\alpha}\left(|f|-\dfrac{1-\alpha}{2T}\right)\right], & \dfrac{1-\alpha}{2T} \le |f| \le \dfrac{1+\alpha}{2T} \\ 0, & |f| > \dfrac{1+\alpha}{2T} \end{cases}$$

is the raised cosine (RC) filter. Explain in details what rules the RRC filters play from the following aspects:

(10%)　(a) Output SNR of the receiver

(15%)　(b) Bandlimited channel

3. Consider the system shown below. Assume the average value of $m(t)$ is zero and the maximum value of $|m(t)|$ is M. Suppose $m(t)$ is a narrowband signal within maximal frequency W. Assume the square-law device is defined by $y(t) = 4x(t) + 2x^2(t)$



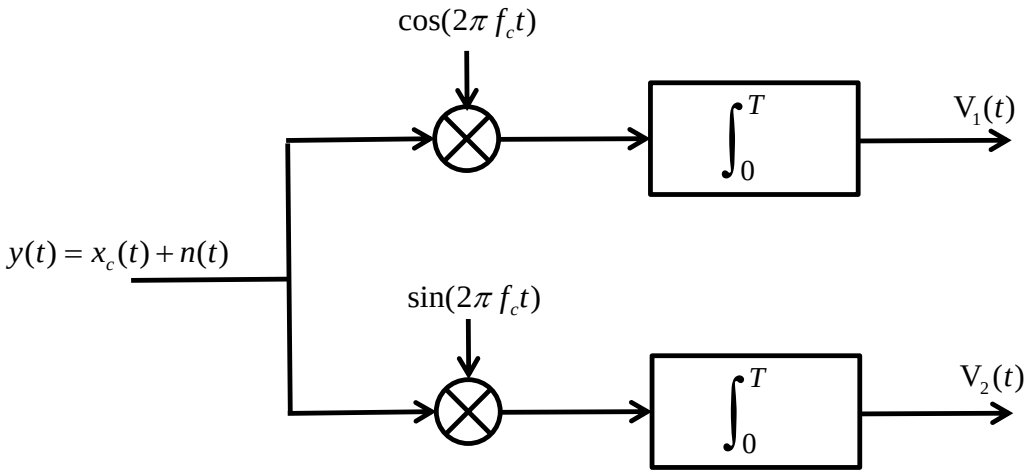
(10%)　(a) Derive the signal $y(t)$.

(15%)　(b) Design the filter that yields an AM signal for $g(t)$.

4. Consider the QPSK demodulator shown below. Assume the QPSK modulator produces a phase imbalanced signal of the form

$$x_c(t) = Ad_1(t)\cos(2\pi f_c t + \beta/2) - Ad_2(t)\sin(2\pi f_c t - \beta/2)$$

where $d_1(t)$ and $d_2(t)$ are "+1" or "-1" of duration T with equal probability and $\beta \neq 0$. Assume the system is synchronized in terms of time slots. Assume $n(t)$ is additive white Gaussian noise with double-sided power spectral density $N_0/2$.



(10%) (a) Find the integrator outputs, i.e., $V_1(t)$ and $V_2(t)$.

(15%) (b) Find the probability of error per quadrature channel.