國 立 臺 北 科 技 大 學

一百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【5】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. (20%)

Consider the following signal:

$$x(t) = 40\text{sinc}(20t)$$

(10%)(1) Derive the Fourier transform of $x(t)$

(10%)(2) Computer the energy of $x(t)$

(hint: use Parserval's theorem for Fourier transforms)

2. (20%)

Consider the set of two functions given by

$$\phi_1(t) = \begin{cases} 1, & 0 \le t < 1 \\ 0, & 1 \le t < 2 \end{cases} \qquad \phi_2(t) = \begin{cases} 0, & 0 \le t < 1 \\ 1, & 1 \le t < 2 \end{cases}$$

The signal $x(t) = \sin(\pi t),\ 0 \le t < 2,$ is to be approximated by

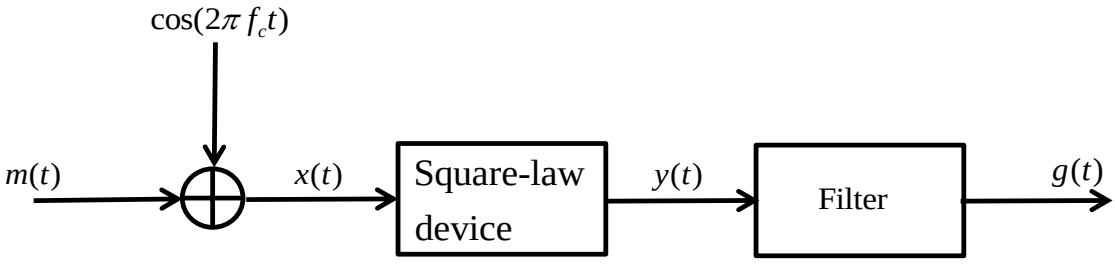
$$x(t) = a_1\phi_1(t) + a_2\phi_2(t)$$

(10%)(1)Show that $\phi_1(t)$ and $\phi_2(t)$ are orthonormal basis for $0 \le t < 2$

(10%)(2)Derive a_1 and a_2 using the inner-product concept.

3. (20%)

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) Design the filter that yields an AM signal for $g(t)$

(10%) (b) What value of M yields a modulation index of 0.1?

4. (20%)

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

(10%) (b) Bandlimited channel

5. (20%)

AWGN is often used to model or describe noise in many communication systems.

(10%) (a) Explain the acronym AWGN. Particularly, what do the letters ‘A’, ‘W’ and ‘G’ stand for

(10%) (b) Why AWGN can be applied (and often applied) as noise model in many communication systems ?