國 立 臺 北 科 技 大 學

一ㄧ二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%)

Given a filter with frequency response function:

$$F[h(t)] = H(f) = \frac{5}{4 + j(2\pi f)}$$

and given an input $x(t) = e^{-3t}u(t)$ with its Fourier transform as

$$F[x(t)] = X(f) = \frac{1}{3 + j(2\pi f)}$$

(10%) (a) Obtain the energy spectral density $G_x(f)$ for the input signal $x(t)$

(10%) (b) Obtain the energy spectral density $G_y(f)$ for the output signal y(t)

2.(20%)

Assume a message signal is given by $m(t) = 2\cos(2\pi f_m t) + \cos(4\pi f_m t)$.

Let $x_c(t) = 2m(t)\cos(2\pi f_c t) + 2\hat{m}(t)\sin(2\pi f_c t),$ where $\hat{m}(t)$ is the Hilbert Transform of $m(t)$.

(10%) (a) Derive $x_c(t)$

(10%) (b) Prove that $x_c(t)$ is a lower-sideband SSB signal of $m(t)$.

3.(20%)

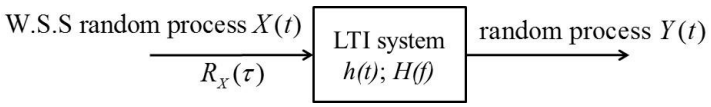
Frequency descrimination is a key step in FM demodulation.

Consider $x(t) = \cos(2\pi f_c t + \phi(t))$. How would you get $\phi(t)$, which reflects the transmitted message signal?

Show your approach in details so that $\phi(t)$ can be extracted by following your suggested method step-by-step.

4.(20%)

Consider a linear system $h(t)$ and a W.S.S. random process $X(t)$ as shown below.



(10%) (a) Show that $E[Y(t)] = E[X(t)]H(0)$

(10%) (b) Show that $R_Y(\tau) = h(-\tau) * h(\tau) * R_X(\tau),$ and hence $S_Y(f) = |H(f)|^2 S_X(f)$

5.(20%)

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

Explain the acronym 'AWGN'

(5%) (a)"A" stand for "additive." Explain what does it mean?

(5%) (b)"W" stand for "white." Explain what does it mean?

(5%) (c)"G" stand for "Gaussian." Explain what does it mean?

(5%) (d)What does "N" stand for?