

系別：電機工程學系

科目：通 信 系 統

准帶項目請打「V」

簡單型計算機

本試題共 / 頁， 7 大題

1. [10%] Show that Fourier Transform of

$$\mathcal{F}\left[\frac{1}{2}\left(\delta\left(t + \frac{1}{2}\right) + \delta\left(t - \frac{1}{2}\right)\right)\right] =$$

2. [10%] Determine the Fourier Transform of

$$\mathcal{F}[t \operatorname{sinc}(t)] =$$

3. [10%] Show that the Hilbert transform of

$$e^{j2\pi f_0 t}$$

4. [20%]

The PM modulated signal is

$$\begin{aligned} u(t) &= 100 \cos\left(2\pi f_c t + \frac{\pi}{2} \cos(2\pi 1000t)\right) \\ &= \sum_{n=-\infty}^{\infty} 100 J_n\left(\frac{\pi}{2}\right) \cos(2\pi(10^8 + n10^3)t) \end{aligned}$$

Using the Carson's rule, determine the approximate bandwidth of the PM signal?

5. [20%] The stationary process  $X(t)$  has a power-spectral density  $S_X(f)$ : (a). what is the power-spectral density of  $Y(t)=X(t)-X(t-T)$ ? (b). what is the power-spectral density of  $Z(t)=d(X(t))/dt-X(t)$ ?

6. [20%]

Consider a sinusoidal signal with random phase, defined by

$$X(t) = A \cos(2\pi f_c t + \Theta)$$

where  $A$  and  $f_c$  are constants and  $\Theta$  is a random variable that is *uniformly distributed* over the interval  $(-\pi, \pi)$ , that is,

$$f_{\Theta}(\theta) = \begin{cases} \frac{1}{2\pi}, & -\pi \leq \theta \leq \pi \\ 0, & \text{elsewhere} \end{cases}$$

This means that the random variable  $\Theta$  is equally likely to have any value in the interval  $(-\pi, \pi)$ . The autocorrelation function of  $X(t)$  is ?

7. [10%]

Please explain the threshold effect in FM ?