淡江大學九十二學年度碩士班招生考試試題

系別：電機工程學系　　　　科目：通信系統

准帶項目請打「○」否則打「x」
○　簡單型計算機

本試題共 **1** 頁

1. [25] 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 Θ is a random variable uniformly distributed over $[-\pi, \pi]$, that is
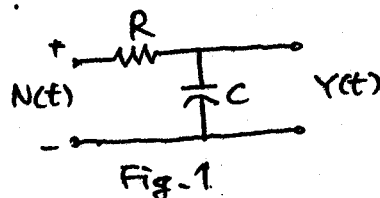
$$f_\Theta(\theta) = \begin{cases} 1/2\pi, & -\pi \le \theta \le \pi \\ 0, & \text{elsewhere} \end{cases}$$

Find the autocorrelation function $R_X(\tau) = E[X(t)X(t+\tau)]$.

2. [25] A random noise N(t) with autocorrelation function $R_N(\tau) = \frac{N_0}{2}\delta(\tau)$ is fed into a lowpass filter as shown in Fig. 1.

   (a) Find the power spectral density $S_Y(f)$ of the filter output Y(t)

   (b) Find the autocorrelation function $R_Y(\tau)$.

Fig. 1

3. [25] Find the instantaneous frequency of

$$s(t) = \cos t \cos t^2 - \sin t \sin t^2.$$

4. [25] Let the signal X(t) has a Fourier transform $X(f) = A(f)e^{j\Theta(f)}$ where A(f) and $\Theta(f)$ are real. Find the Fourier transform of the following signal in terms of X(f):

$$y(t) = x(t)\cos(2\pi f_c t + \pi/4).$$