國立臺北科技大學

九十四學年度電機工程系博士班入學考試

通訊原理試題

填准考證號碼

注意事項：

1. 本試題共四題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. The filter input $x(t)$ consists of a pulse signal $g(t)$ corrupted by additive white Gaussion noise $w(t)$, as shown by
$x(t) = g(t) + w(t), 0 \le t \le T$.

   Please derive the optimal match filter $h_{opt}(t)$.(20%)

2. Consider a linear prediction filter, the filter output $\hat{x}[n]$ is defined as below:

$$\hat{x}[n] = \sum_{k=1}^{p} w_k x[n-k]$$

   The p is the prediction order. The w_k is the predictive coefficient. The mean square value J of prediction error is defined as below:

$$J = E[(x[n] - \hat{x}[n])^2]$$

   Please derive and prove the following equations.

$$w_O = R_x^{-1} r_x$$
$$J_{\min} = \sigma_x^2 - r_x^T R_x^{-1} r_x$$

   (The w_O is the optimum coefficient vector. The $J_{\min}$ is the minimum mean square

value of the prediction error. The r_x is p-by-1 autocorrelation vector. The R_x is p-by-p autocorrelation matrix.)(30%)

3. Consider the process $X(t)$:

$$X(t) = A\sin^2(2\pi f_c t + \theta)$$

where the amplitude A and the frequency f_c are constant and the phase θ is uniformly distributed at $[0,2\pi]$. Please **prove** whether or not this process $X(t)$ is wide-sense stationary(WSS).(25%)

4. Continued the Problem #2. Please find the auto-correlation function $R_x(\tau)$ and the power spectral density function $G_x(f)$ of $X(t)$.(25%)