國立臺北科技大學

九十三學年度電機工程系碩士班入學考試

通訊原理試題

填准考證號碼 第一頁 共一頁

注意事項：

1. 本試題共九題，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. (a) Please write down the equation for the Shannon's information capacity theorem.(5%)
   (b) According to the Shannon's theorem, if the bandwidth of channel is 10kHz, the minimal requirement of the transmitted rate is 56k bit/Second. Please find the value of SNR to meet this requirement.(5%)

2. (a) Please state the properties for the wide-sense stationary(WSS). (5%)
   (b) The process x(t) listed as below is WSS ? Please prove it. (10%)
   $x(t) = A\cos^2(2\pi ft + \theta)$, where the θ is uniformly distributed random variable over the interval $[-\pi, \pi]$.

3. (a) The power spectrum density(PSD) $S_x(f)$ and the autocorrelation function $R_x(\tau)$ of a stationary process $x(t)$ form a Fourier-transform pair. Please prove it. (10%)
   (b) Please find the PSD of the process $x(t)$ defined as below: (5%)

   $x(t) = A * \sin^2(2\pi f_c t + \theta)$, where the θ is uniformly distributed random variable over the interval $[-\pi, \pi]$.

4. Please prove that:
   (a) A signal $g(t)$ and its Hilbert transform $\hat{g}(t)$ have the same magnitude spectrum.(5%)
   (b) If $\hat{g}(t)$ is the Hilbert transform of $g(t)$, then the Hilbert transform of $\hat{g}(t)$ is $-g(t)$.(5%)

5. A FM signal is defined as $s(t) = A_c \cos(2\pi f_c t + 2\pi \int_0^t m(\tau)d\tau)$. The modulating signal $m(t)$ is defined as below:

   $m(t) = A_m \sin^2(2\pi f_m t)$

   Please find the approximate form of a narrowband($\frac{A_m}{f_m}$ is small compared to one radian) FM signal.(10%)

6. The AM signal is defined as below: (10%)
   $s(t) = A_c[1 + 0.8\sin(2\pi f_m t)]\cos(2\pi f_c t)$
   Please find the value of $\frac{(SNR)_O}{(SNR)_C}$.

7. According to the Nyquist's theorem, to avoid the aliasing effect, please find the minimal sample rate(Hz) for the following signal. (10%)
   (a) $g(t) = \sin c(100\pi t)$
   (b) $g(t) = \sin c^2(100\pi t)$
   (c) $g(t) = \sin c(100\pi t) + \sin c^2(100\pi t)$
   (d) $g(t) = \sin c(100\pi t) * \sin c^2(100\pi t)$

8. 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 $h_{opt}(t)$.(10%)

9. (a) Please sketch the waveforms of the in-phase and quadrature components of the MSK signal in response to the input binary sequence 10101100011. (5%)
   (b) Please sketch the MSK waveform itself for the binary sequence specified in part (a). (5%)