國立臺北科技大學 103 學年度碩士班招生考試

系所組別：2140 電機工程系碩士班丁組

第二節　通訊原理　試題

注意事項：

1. 本試題共 5 題，配分共 100 分。
2. 請標明大題、子題編號作答，不必抄題。
3. 全部答案均須在答案卷之答案欄內作答，否則不予計分。

1. (30%) Briefly answer the following problems.

(a) What is the power spectral density (PSD)? Please explain its physical meaning and application. (5%)

(b) What is the Manchester code (or split code)? Please plot the symbols stand for symbol 1 and symbol 0, respectively, and also describe the feature of individual power spectrum. (5%)

(c) Why orthogonal frequency division multiplexing (OFDM) can approximately convert frequency selective fading channel into flat fading subchannels? (5%)

(d) Describe the characteristics of additive white Gaussian noise (AWGN) from both the viewpoints of time domain and frequency domain. (5%)

(e) What is the advantage of QPSK as compared to BPSK? (5%)

(f) Why the noise performance of an AM receiver using envelope detection is always inferior to that of a DSB-SC receiver? (5%)

2. (15%) Find the Fourier transform (expressed by $S(f)$) for each of the following signals. Note that $\text{sinc}(\lambda)=\dfrac{\sin \pi\lambda}{\pi\lambda}$.

(a) $s(t)=\text{sinc}(2t-20)\times e^{j100\pi t}$, (5%)

(b) $s(t)=e^{j(3t-5)}$, (5%)

(c) $s(t)=\cos[100\pi(t-5)]$. (5%)

3. (20%) Consider a pair of quadrature-modulated processes $X_1(t) = X(t)\cos(2\pi f_c t + \Theta)$ and $X_2(t) = X(t)\sin(2\pi f_c t + \Theta)$, where $X(t)$ is a wide-sense stationary process, Θ is a random variable uniformly distributed over $[0, 2\pi]$ and is independent of $X(t)$, f_c is a constant. Answer the following problems.

(a) Calculate the cross-correlation function of $X_1(t)$ and $X_2(t)$, which is defined as $R_{12}(\tau) = E[X_1(t)X_2(t-\tau)]$. (10%)

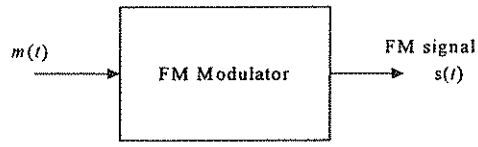
(b) What condition will make $R_{12}(\tau) = 0$? What is the physical meaning of $R_{12}(\tau) = 0$? (10%)

4. (15%) An FM system with $k_f = 10^6$ and carrier wave $c(t) = \cos 2\pi 10^8 t$ is shown below. Assume that $m(t) = \cos 2\pi 10^6 t$ volt.

(a) Write down the equation of the resulting FM signal $s(t)$ in terms of modulation index β, f_c and f_m. (5%)

(b) Calculate the maximum and minimum instantaneous frequencies of $s(t)$. (5%)

(c) Estimate bandwidth of $s(t)$ using Carson's rule. (5%)



5. (20%) A speech signal is transmitted using an M-ary PAM system. The sampling rate is 10^5 samples/sec and each sample is quantized to one of 256 levels (i.e.,8-bit quantization). Determine the minimum required bandwidth for transmitting the PAM wave if

(a) M=4 using an ideal Nyquist channel. (10%)

(b) M=16 using channel with raised cosine spectrum of $\alpha = 1$. (10%)