國立中央大學通訊工程學系 101 學年度碩士在職專班入學筆試

【基本通訊概論】試卷

考試地點：通訊館一樓 E1-109 室　　考試時間：100 分鐘　　試題總分：100分

1. For a pulse signal $p(t)=\begin{cases}1, 0\le t\le T\\ 0, \text{ otherwise}\end{cases}$, (a) plot the waveform $x(t)=\sum_{n=0}^{3} a_n\cdot p(t-n\cdot T)$ when $a_0=1,\ a_1=-1, a_2=2, a_3=-2$; (b) find $P(f)=\Im\{p(t)\}$ in terms of sinc( ) ; (c) plot the waveform $y(t)=\int_{-\infty}^{\infty} p(t-\tau)\cdot p(\tau)d\tau$. (Hint: $X(f)=\Im\{x(t)\}=\int_{-\infty}^{\infty} x(t)\cdot e^{-j2\pi f t}dt$: Fourier transform of $x(t)$; $\text{sinc}(x)=\frac{\sin(\pi\cdot x)}{\pi\cdot x}$) (15%)

2. For a message signal $m(t)$ with $M(f)=\Im\{m(t)\}=\begin{cases}1, & 0.2W<|f|<W\\ 0, & \text{otherwise}\end{cases}$, (a) plot $M(f)$; (b) plot the Fourier transform $X(f)=\frac{1}{2}\left[M(f-f_0)+M^*(-f-f_0)\right]$, $f_0=4W$; (c) find the signal $x(t)=\Im^{-1}\{X(f)\}$ in terms of $m(t)$; (d) plot the Fourier transform $M_\delta(f)=\Im\left\{\sum_{n=-\infty}^{\infty} m(n\cdot T)\cdot\delta(t-n\cdot T)\right\}=\frac{1}{T}\sum_{k=-\infty}^{\infty} M\left(f-k\cdot\frac{1}{T}\right)$ when $\frac{1}{T}=3\cdot W$. (Hint: $x(t)=\Im^{-1}\{X(f)\}$: inverse Fourier transform) (20%)

3. For a received signal in a digital communication system given by $r_k=a_k+n_k$, $\Pr(a_k=1)=\Pr(a_k=-1)=0.5$ and n_k being a Gaussian noise with a probability density function $f_N(n_k)=\frac{1}{\sqrt{2\pi\cdot\sigma_n^2}}\exp\left(\frac{-n_k^2}{2\sigma_n^2}\right)$; (a) find $\Pr(n_k<0)$; (b) find $\Pr(r_k>0\,|\,a_k=-1)$ in terms of $Q(\ )$; (c) find $E\{r_k\}$; (d) find $E\{r_k^2\}$. (Hint: $\int_{-\infty}^{\infty}\frac{1}{\sqrt{2\pi\cdot\sigma_n^2}}\exp\left(\frac{-x^2}{2\sigma_n^2}\right)\cdot dx=1$, $Q\left(\frac{A}{\sigma_n}\right)=\int_{A}^{\infty}\frac{1}{\sqrt{2\pi\cdot\sigma_n^2}}\exp\left(\frac{-x^2}{2\sigma_n^2}\right)\cdot dx=1$, $\Pr(A|B)$: probability of event A condition on event B, $E\{x\}=\sum_x x\cdot\Pr(x)$: expectation) (20%)

4. For a PCM system with $q-$bit quantization used for transmitting/storing an analog signal $m(t)$, find the required minimum data rate when (a) the signal is voice with a bandwidth of 4 KHz and $q=8$, (b) the signal is video with a bandwidth of 6 MHz and $q=24$. (10%)
5. Explain the following terms: (a) Cellular communication; (b) Throughput; (c) Bandwidth efficiency; (d) Ethernet; (e) Channel coding; (f) Source coding; (g) Multiple Access. (35%)