國立中央大學 108 學年度碩士班考試入學試題

所別： 通訊工程學系碩士班 不分組(一般生)

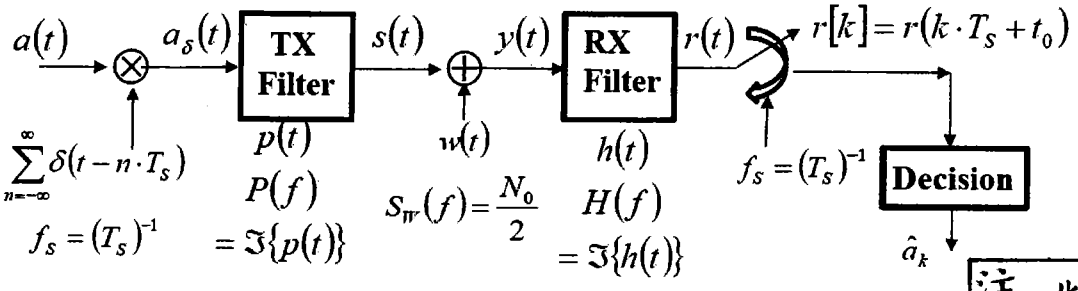
科目： 通訊系統

本科考試禁用計算器

1. (50%) For a baseband communication system as shown below, where $w(t)$ is the additive white Gaussian noise with a power spectral density $N_0/2$ and $p(t)/h(t)$ denote the impulse responses of TX/RX filters, (a) plot the Fourier spectrum $A_\delta(f)=\Im\{a_\delta(t)\}$ in the range $|f|\le 2f_S$ when $A(f)=\Im\{a(t)\}=\begin{cases}1, & |f|\le 0.4f_S\\ 0, & otherwise\end{cases}$ (5%); (b) find the values f_{pass} and f_{stop} in $P(f)=\begin{cases}1, & f\le f_{pass}\\ 0, & f>f_{stop}\end{cases}$ such that $s(t)=K\cdot a(t)$ and $f_{stop}-f_{pass}$ is maximized for the signal $a(t)$ given in (a) (5%); (c) plot the waveform $r(t)$ in the range $0\le t\le 5\cdot T_S$ when $h(t)=p(t)=\begin{cases}2, & 0\le t\le 0.5T_S\\ 0, & otherwise\end{cases}$, $N_0=0$ and $\{a(n\cdot T_S)\,|\,n=0\sim 4\}=\{1,-1,-3,3,-1\}$ (5%); (d) find the received signal power $\left(E\{r^2(t)\}\right)$ in terms of N_0 when $h(t)=\begin{cases}2, & 0\le t\le 0.5T_S\\ 0, & otherwise\end{cases}$ and $s(t)=0$ (5%); (e) find the values A_0, t_0 and $E\{n_k^2\}$ in $r[k]=A_0\cdot a(k\cdot T_S)+n_k$ such that A_0 is maximized when $h(t)=p(t)=\begin{cases}2, & 0\le t\le 0.5T_S\\ 0, & otherwise\end{cases}$ and $N_0\ne 0$ (12%); (f) find the optimal decision rule for $r[k]$ given in (e) when $a(k\cdot T_S)\in\{-3,-1,1,3\}$ with equal probability (5%); (g) find the decision error probability for the decision rule given in (f) in terms of A_0, N_0 and $Q(x)$ (8%); (h) find the data rate (bps: bit-per-sec) of the system when $a(k\cdot T_S)\in\{-7,-5,-3,-1,1,3,5,7\}$ (5%).

$$\left(\text{Hint}: Q(x)=\frac{1}{\sqrt{2\pi}}\int_x^\infty \exp\left(\frac{-y^2}{2}\right)dy,\quad \Pr(n>A)=Q\left(\frac{A}{\sigma}\right),\quad n\sim N(0,\sigma^2)\right)$$

$$\left(\text{Hint}: s(t)=a_\delta(t)*p(t)=\sum_n a(n\cdot T_S)\cdot p(t-n\cdot T_S),\quad \Im\{\,\}:\text{Fourier Transform}\right)$$



注：背面有試題

國立中央大學 108 學年度碩士班考試入學試題

所別： 通訊工程學系碩士班 不分組(一般生)　　共 2 頁 第 2 頁

科目： 通訊系統

本科考試禁用計算器

2. (8%) Consider the received FM signal $x(t) = A_c \cos(2\pi f_c t + 2\pi f_d \int^t m(\alpha)d\alpha) + n(t)$ where $m(t)$ is the lowpass message signal with bandwidth W and $n(t)$ is the AWGN with double-sided PSD $N_0/2$. For a fixed value of $\frac{A_c^2}{N_0 W}$, if we increase the value of f_d, will the SNR of the demodulated signal increase also? Please explain your answer.

3. (10%) An AM modulator operates with the message signal $m(t) = 4\cos(10\pi t) + 6\cos(30\pi t)$. The unmodulated carrier is $200\cos(600\pi t)$. The system operates with a modulation index of 0.8.
(a) Write the equation for $m_n(t)$, the normalized signal with a minimum value of -1. (3%)
(b) Determine $< m_n^2(t) >$, the power in $m_n(t)$.(4%)
(c) Determine the efficiency of the modulator. (3%)

4. (24%) Consider M-ary PSK (phase-shift keying) and M-ary FSK (frequency-shift keying).
(a) For $M = 2$, plot the receiver structures and find the bit error probabilities for both. (8%)
(b) For $M = 2^m$ where $m \geq 2$ is an integer, find the approximated symbol error probabilities versus E_s/N_0 for both (E_s is the energy per symbol). (8%)
(c) For $M = 2^m$ where $m \geq 2$ is an integer, find the approximated bit error probabilities versus E_b/N_0 for both (E_b is the energy per bit). Please compare the approximated bit error probabilities of PSK and FSK if we increase the value of m (8%).

5. (8%) Consider QPSK (quadriphase-shift keying) and 16-QAM (quadrature-amplitude modulation). Please compare their symbol error probabilities and null-to-null bandwidths in the case of the same data rate.

注意:背面有試題