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(1) 解：平均信息量公式：$H=-\sum_{i=1}^{M} P(x_i)\log_N P(x_i)$

$N=2,4,8,\cdots$

单位：比特/符号

码元传输速率 R_B，信息传输速率 R_b

关系：$R_b = R_B \cdot H$

(2) 答：条件：① 分布函数与时间t无关，为常数；
② 自相关函数只与时间间隔有关

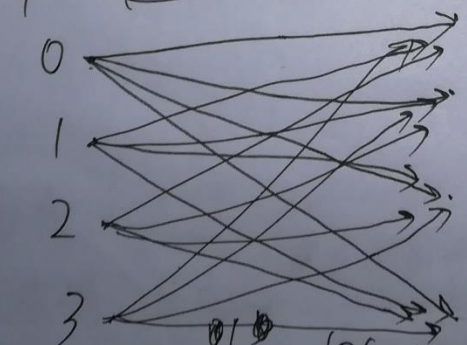
各态历经性条件：$\begin{cases} a=\bar{a} \\ R(r)=\overline{R(r)} \end{cases}$，即 时间平均=统计平均

(3) 答：平均功率：$R(0)=E[f(t)]$

直流功率：$R(\infty)=E^2[f(t)]$

交流功率：$R(0)-R(\infty)$

(4) 解：



$P(0/2)=\frac{1}{16}$　$P(0/3)=\frac{1}{16}$

$P(1/2)=\frac{1}{16}$　$P(1/3)=\frac{1}{16}$

$P(2/2)=\frac{1}{16}$　$P(2/3)=\frac{1}{16}$

$P(3/2)=\frac{1}{16}$　$P(3/3)=\frac{1}{16}$

$P(0/0)=\frac{1}{16}$

$P(1/0)=\frac{1}{16}$

$P(2/0)=\frac{1}{16}$

$P(3/0)=\frac{1}{16}$

$P(0/1)=\frac{1}{16}$

$P(1/1)=\frac{1}{16}$

$P(2/1)=\frac{1}{16}$

$P(3/1)=\frac{1}{16}$

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(4) 解: $\eta = \frac{R_B}{B} = \frac{2}{1+\alpha} = \frac{2}{1.5} = 73\%$

$B = \frac{1}{2T_s} = \frac{f_N}{2}$ (Baud)

(6) 答:

(7) 答: AMI编码: 利用信号极性交换规律观察误码情况

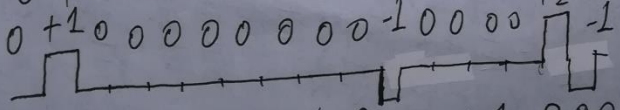
HDB_3编码: 连续4个"0"以上服电子无所同步.

(8) 答: ~~$(2B + \frac{S}{N})$~~ $C_t = B\log_2(1+\frac{S}{N})$ (b/s).

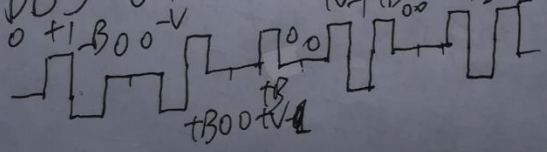
二、小解:

(1) 0 | 00000000 | 000∗11

AMI: 0 +1 00000000 -1 0000 +1 -1

电波形: 

(2) HDB3: 0 +1 -B00 -V +1 +B00 +V -1 +B00 +V -1 +1

电波: 

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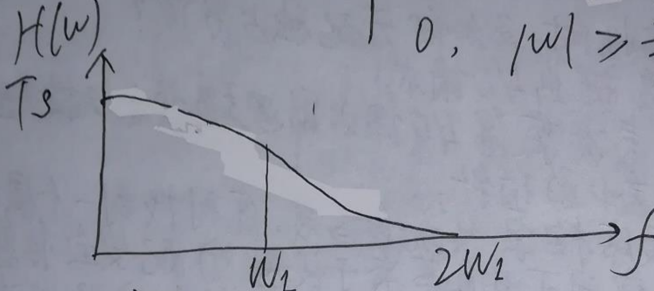
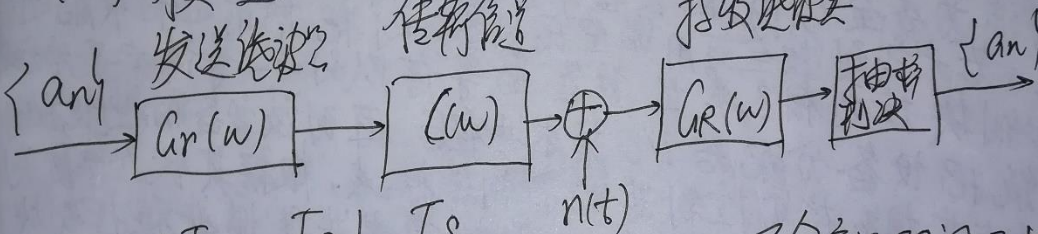
四、解：(1)

$$H(w)=\begin{cases} T_s, & 0\le |w| < \frac{1-1}{T_s}\pi=0 \\ \frac{T_s}{2}\left[1+\sin\frac{T_s}{2}\left(\frac{\pi}{T_s}-w\right)\right], & 0<|w|<\frac{2\pi}{T_s} \\ 0, & |w|\ge \frac{2\pi}{T_s} \end{cases}$$



(2) 模型：



(3) $\left|\frac{T_s}{2}-\frac{T_s}{3}\right|=\frac{T_s}{6}<T_s \Rightarrow$ 不会产生码间干扰

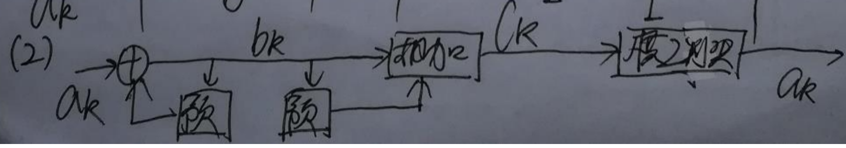
五、解：(1)

预编码：$a_k=b_k\oplus b_{k-1}$　相关编码：$C_k=b_k+b_{k-1}$

模2：$a_k=b_k\oplus b_{k-1}$

a_k	1	0	1	1	0	1	0	1
b_{k-1}	0	1	1	0	1	0	0	1
b_k	1	1	0	1	1	0	1	1
b_k'	+	+	-	+	+	+	-	+
C_k	0	+2	0	0	+2	+1	0	+2
a_k'	1	0	1	1	0	1	1	1

(2)



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六、答：(1) 带宽：$2ASK = 2f_s = 2FSK < 2PSK = f_s - f_1 + 2f_s$.

抗干扰：相干：$2PSK < 2ASK < 2FSK$

非相干：$2ASK < 2FSK$

(2) TS0：语音码

TS16：信令

(3).

(4) $2^r - 1 \geq r + k + 1$

要纠两错：2位

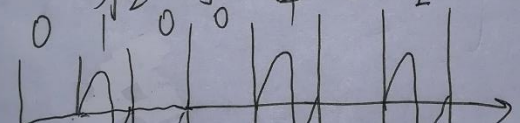
纠错：1位

检测：1位

0 1

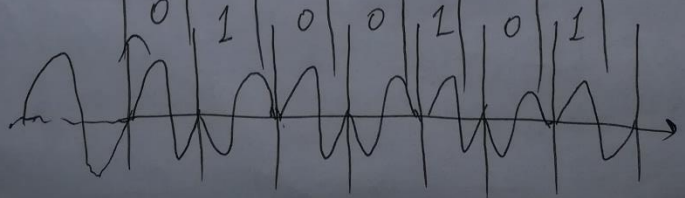
七、略：

(1) 2ASK：



2PSK：

2DPSK：



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(2)

(3) $B_{2ASK} = B_{2PSK} = B_{2DPSK} = 2R_B = 5000Hz$

$B_{2FSK} = 2(f_2 - f_1) + f_S = 2 \times (2500 - 1500) + 2500Hz$

$= 4500Hz$

十一、解：(1) 3×96

八、解：~~设 $S_k(t)=\cos(1600t+1000\pi a_k t+\varphi_k)$ $(k-1)T_s<t\le kT_s$~~

(4) 设 $S_k(t)=\cos(1600t+1000\pi a_k t+\varphi_k)$, $(k-1)T_s<t<kT_s$

(1) "1" —— $a_k=+1$, $f_1=2000+\frac{1}{4\times0.5\times10^{-3}}=7000Hz$

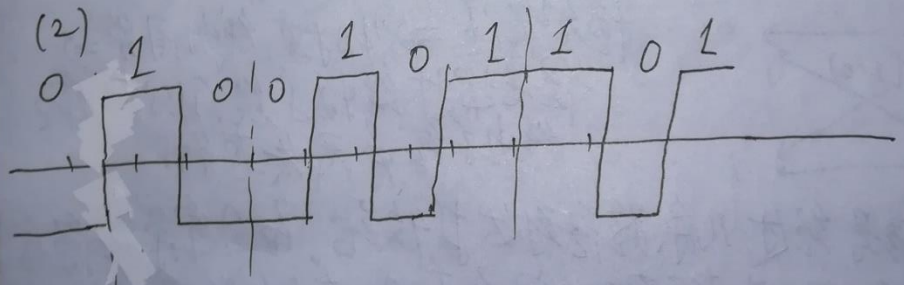
"0" —— $a_k=-1$,

$f_0=f_c-\frac{1}{4T_s}$

$=2000-\frac{1}{4\times0.5\times10^{-3}}$

$=1000Hz$

(2)



(3)

2500 Hz

= 4500 Hz

十一、解：(1) 3 × 96

$n=6$, $k=3$

(2) $\begin{bmatrix} 0\,0 & 0 & 1 & 1 \\ 1\,0 & 0 & 1 & 0 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0\,0 & 1 & 0 & 1 & 1 \\ 1\,0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 1 & 0 \end{bmatrix} \Rightarrow$

$\begin{bmatrix} 0\,0 & 1 & 0 & 1 & 1 \\ 1\,0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \end{bmatrix} \Rightarrow \begin{bmatrix} 0\,0 & 0 & 0 & 0 & 1 \\ 1\,0 & 1 & 1 & 1 & 1 \\ 0 & 1 & 0 & 1 & 0 & 0 \end{bmatrix} \Rightarrow$

$\begin{bmatrix} 0\,0\,0 & 0 & 0 & 1 \\ 1\,0 & 1 & 0 & 1 & 0 \\ 0 & 1 & 0 & 1 & 0 & 0 \end{bmatrix} = H$

十二、解：$g(x) = 0\,0\,1\,0\,1\,1\,1$

$7-3=4 \Rightarrow$

$G(x) = \begin{bmatrix} x^2 g(x) \\ x\,g(x) \\ g(x) \end{bmatrix} =$ [illegible]

$G(x) = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix} \Rightarrow$ 典型生成矩阵

$G(x) = \begin{bmatrix} 1 & 0 & 1 & 1 & 0 & 0 & 0 \\ 0 & 1 & 0 & 1 & 1 & 1 & 0 \\ 0 & 0 & 1 & 0 & 1 & 1 & 1 \end{bmatrix}$