| Set | Problem | Principle |
| ---: | :---: | :--- |
| 5 | $3-21$ | Multi-level PAM (buad rate is symbol rate) |
| 5 | $3-39$ | Multilevel PCM bit and baud rate |
| 5 | $3-42 \mathrm{a}$ | Raised cosine-rolloff filter, ISI (3-74) |
| 5 | $3-50$ | PCM Bit rate for given BW with raised cosine-rolloff (3- |
| 5 | $3-51$ | Muliti-level PCM with raised cosine-rolloff |

3-21
(a) $L=2^{l}=16 \quad \Rightarrow \quad l=4$ bit $/$ level
(b) $D=\frac{N}{T^{+}}=\frac{15 y m b o l}{0.8 \times 10^{-3} \mathrm{sec}}=\underline{\underline{1,250 \text { baud }}}$
(c) $R=\ell D=4(1,250)=5 \mathrm{kbits} / \mathrm{sec}$

3-39 Use the result from Rote 3-8,
(a) $n \geq 3.32 \log _{n}\left(\frac{50}{\rho}\right)=3.32$ host $_{n}(50)=5.64 \neq u_{5 e} n=6$ bitt $/$ wood .

$$
f_{3}=28=5.4 \mathrm{kkt} \Rightarrow R_{\mathrm{min}} n f_{5}=6(54 \mathrm{kN} / 7)=32.4 \mathrm{kbita} / \mathrm{rec}
$$

 (C) $D=\frac{2 B}{1+r}$ where r $=0$ for $\mathrm{min} B W \Rightarrow B=\frac{D}{2}=5.4 \mathrm{kN/3}$

3-42
(a.) $\left.B=\frac{1}{2}(1+r) D=\frac{1}{2} R=\frac{1}{2} 300\right)=150 \mathrm{~Hz}$

3-50

$$
M=16=2^{4} \Rightarrow n=4
$$

(a) Binary $P C M \Rightarrow l=1, \quad R=n F_{5}=4-\frac{f}{G}=D$

$$
D=\frac{2 B}{1+r}=\frac{2(4 \mathrm{kH})}{1+0.5}=5.33 \mathrm{kbits} / \mathrm{sec}
$$

(b) From (a) $f_{J}=\frac{D}{4}=\frac{5.33 \mathrm{~K}}{4}=1.33 \mathrm{kHz}$

$$
B_{\substack{n_{c \mid l o g} \\ \text { max }}}=\frac{f_{s}}{2}=\frac{1.33 k}{2}=667 \mathrm{~Hz}
$$

3-51 $L=2^{l}=4 \Rightarrow l=2$
(a)

$$
\begin{aligned}
D=\frac{R}{l} & =\frac{R}{2} \\
& \Rightarrow R=2 D=2\left(\frac{2 B}{1+r}\right)=10.67 \text { kbit/ Fec }
\end{aligned}
$$

(b)

$$
\begin{aligned}
& M=2^{n}=L^{N}=\left(2^{l}\right)^{n l}=16 \Rightarrow n=4
\end{aligned}
$$

$$
\begin{aligned}
& B_{\text {analog }}=\frac{f_{5}}{2}=\frac{2.66 \mathrm{k}}{2}=\frac{1.33 \mathrm{kAz}}{\text { matal }}
\end{aligned}
$$

