

Attenuation

Q1.

a)

$$P_{\text{server}} = 125 \text{ mW} = 10 \log(125 \text{ m})_{\text{dB}} = -9.03 \text{ dB}$$

$$\left. \begin{aligned} P_{\text{client}} &= -9.03 - 2 \times 200 \text{ dB} = -409.03 \text{ dB} = 1.25 \times 10^{-41} \text{ (W)} \\ N &= 4 \times 10^{-21} \times 4000 = 1.6 \times 10^{-15} \text{ (W)} \end{aligned} \right\} \text{SNR} = 10 \log\left(\frac{1.25 \times 10^{-41}}{1.6 \times 10^{-15}}\right) = -261 \text{ dB} < 30 \text{ dB}$$

X ↓
It's unacceptable!

b)

$$\text{SNR} \gg 30 \text{ dB} \rightarrow -261 + 10m \gg 30 \rightarrow m \gg 29.1 \rightarrow \boxed{m=30}$$

$$\text{SNR} = P'_{\text{client (dB)}} - N'_{\text{(dB)}} = (P_{\text{client}} + 10m)_{\text{(dB)}} - N_{\text{(dB)}}$$

$$c) P_{\text{client}} = -9.03 - 0.3 \times 200 = -69.03 \text{ dB} = 1.25 \times 10^{-7} \text{ (W)} \rightarrow \text{SNR} = 78.93 \text{ dB} > 30 \text{ dB}$$

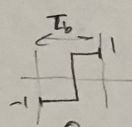
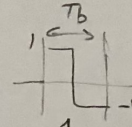
↓ ✓

It's possible to have a successful connection.

Coding

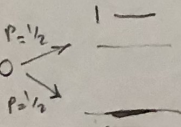
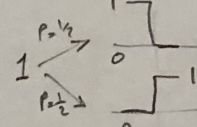
Q1.

a)

i) Manchester encoding   $\rightarrow P = \frac{5}{6} (1^2) + \frac{1}{6} (1^2) = \boxed{1}$

ii) NRZ $\rightarrow P = \frac{5}{6} (0^2) + \frac{1}{6} (1^2) = \boxed{1/6}$

iii) NRZI

  $\rightarrow P = \frac{5}{6} (\frac{1}{2} 1^2 + \frac{1}{2} 0^2) + \frac{1}{6} (\frac{1}{2} \frac{1}{2}^2 + \frac{1}{2} \frac{1}{2}^2) = \boxed{\frac{1}{2}}$

iv) AMI

$$P = \frac{5}{6} (0^2) + \frac{1}{6} (\frac{1}{2}^2 + \frac{1}{2}^2) = \boxed{\frac{1}{6}}$$

b)

i) Manchester encoding: For both strings of consecutive 0s or 1s it's not constant and clock could be synchronized.

ii) NRZ: It's a constant for consecutive bits, so clock can not be synchronized.

iii) NRZI: Clock could be synced if there was a long string of consecutive ones because it's changing with each clock but for zeros clock couldn't be synced.

iv) AMI: For zeros it's not possible but for ones clock could be synced as it changes between 1 and -1 with each clock.

Q2.

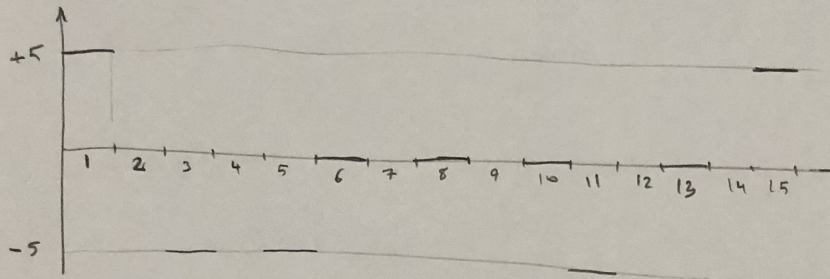
$$\left. \begin{array}{l} A=1 \\ B=0 \end{array} \right\} (1, \alpha, \beta, \gamma) + (-1)(1, -1, -1, 1) = (0, 2, \alpha, -2) \rightarrow \begin{array}{l} \alpha+1=2 \rightarrow \alpha=1 \\ \beta+1=0 \rightarrow \beta=-1 \\ \gamma-1=-2 \rightarrow \gamma=-1 \end{array} \left. \right\} A: (1, 1, -1, -1)$$

$$a) \bar{A} + \bar{C} = (-1, -1, 1, 1) + (-1, 1, -1, 1) = (-2, 0, 0, 2)$$

$$b) S = (-1, -1, -1, 3) \rightarrow \begin{array}{l} S.A = -1 \rightarrow A=0 \\ S.B = 1 \rightarrow B=1 \\ S.C = -1 \rightarrow C=0 \end{array}$$

Q3.

Bipolar:



از آنجا که سیگنال Bipolar است و بیت اول یک است اگر بیت دوم هم یک باشد بیت سوم باید یک باشد نه صفر
بیت 2 = 0

بیت 2 صفر است. ←

$$\text{Bit } 4 = 1$$

از آنجا که 3, 5 فرد یک هستند و معنی صفت چهارم هم یک یک است ←

بیت 5, 11 فرد یک و معنی 5 صفت پس بیت 7 و 9 که یک است 7, 9 را داریم بیاوریم
بیت 7 = 1; Bit 9 = 0
بیت 7 = 0; Bit 9 = 1
یکی از آنها یک و دیگری صفر است. ←

بیت 11, 15 فرد یک و معنی صفت 12, 14 فرد صفر است

$$\text{Bit } 12 = 0; \text{ Bit } 14 = 0$$

$$\text{Bit } 12 = 1; \text{ Bit } 14 = 1$$

$$\text{کد = 1101} : \left\{ \begin{array}{cccccc} \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \\ \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \\ \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \\ \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 1 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} & \begin{array}{|c|} \hline 0 \\ \hline \end{array} \end{array} \begin{array}{l} 2 \quad 4 \quad 7 \quad 9 \quad 12 \quad 14 \end{array}$$