08/28/22. HOME WORK-1.

(1.) Bit Rate = 1000 bits/sec.

No. of symbols = 4 symbols.

Baud Rate = ?

$\boxed{\text{Bit Rate} = \text{Baud Rate} \times [\text{The no. of useful bits carried per symbol}]}$.

1000 bits = Baud Rate × 4

$\frac{1000 \text{ bits}}{4}$ = Baud Rate.

∴ Baud Rate = 250 Bd/s.

(2.) Under what conditions are the Bit Rate and Baud Rate equal for a physical layer transmission?

Ans) When each symbol of a data transmission system carries exactly 1 bit of data.
i.e., when there are only two levels per symbol, representing 0 and 1.

(3.) AGGIE-ID: 800765549; when converted into 8-bit ASCII, it is
1011111011 1010101101 1001101101.

2D-PAM4 :- 2 wires, 4 Amplitude

Baud Rate = 40 Symbols/Sec

a.) $\log_2(1011111011\ 10101011 01 10 01 101101) = 29.57$ bits.

b.) How many useful bits of info can a 2D-PAM4 signal carry per symbol?

Ans.) $4^2 = 16$ Possible symbols.

$\therefore \log_2(n) = \log_2(16) = 4$ bits of info carried in each symbol

c.) How many bits/second can be sent at 40Bd on a 2D-PAM4 signal?

Ans.)

we know that,

$$\boxed{\text{Bit Rate} = \text{Baud Rate} \times [\text{The no. of useful bits carried per symbol}]}$$

$\text{Bit Rate} = 40\ \text{Bd/sec} \times 4\ \text{bits}$

$\therefore \text{Bit Rate} = 160\ \text{bits/sec}$

d.) How many seconds does it take to send out the entire Aggie ID? Round to the nearest.

Ans.) Bit Rate = 29.57 bits.

Baud Rate = 40 Bd/sec.

No. of useful Info bits carried = 4 bits

$$\frac{29.57 \text{ bits}}{x} = \frac{160}{1 \text{ sec}}$$

$$29.57 \text{ bits} = 160x$$

$$160x = 29.57$$

$$x = \frac{29.57}{160} = \underline{0.184 \text{ sec}}$$

$\therefore \underline{x = 184 \text{ milliseconds}}$.

(4.) Propose rules for a line coding scheme that uses 4 voltage levels (1D-PAM4). How many bits per symbol are carried by your line coding scheme? Is it self-clocking?

Ans)

1D-PAM4 :- 1-wire, 4-Amplitude.

→ Since we have only 1-wire, then both 'A' & 'B' uses the same amount of amplitude.

→ Each time we get a pulse, it will have any of 4 values across that 1 wire.

$4^1 = 4$ different possible configurations (or) symbols

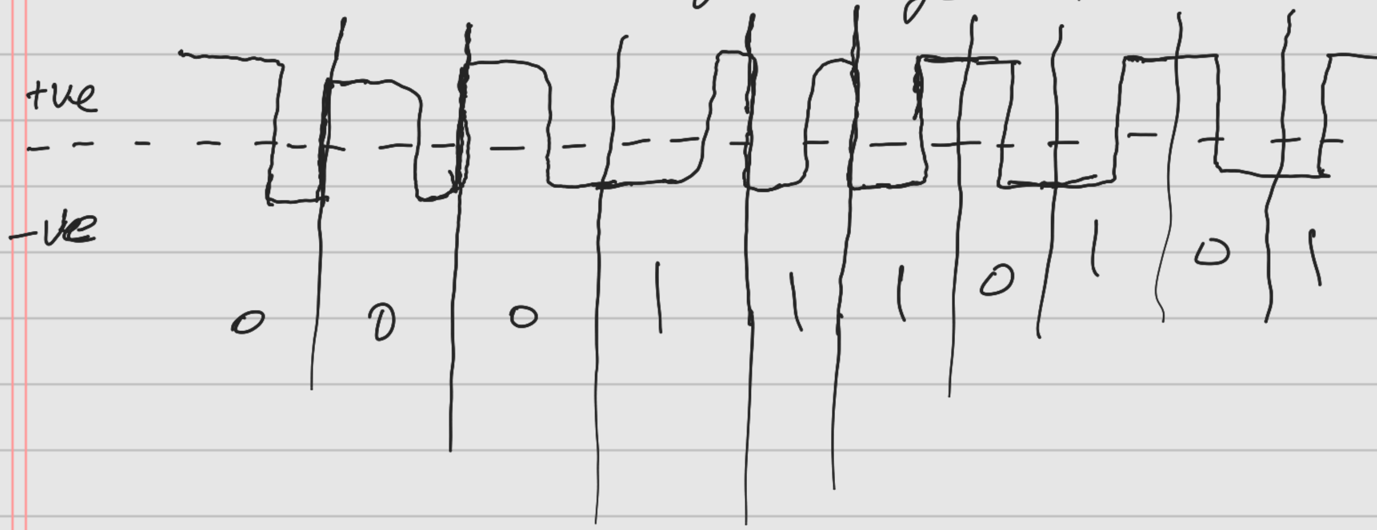
$\log_2(4) = 2$ bits of information is carried in each symbol.

→ Yes, it is self clocking. As it passes 2-bits per symbol for every transition.

5. Manchester Encoding; 0001110101.

→ We know that in Manchester Encoding, a symbol is sent every clock period. The symbol is a voltage transition.

+ve to -ve voltage change = 0
-ve to +ve voltage change = 1



6. If a signal strength at 5 meters away from the transmitter is 10^{-5} mW, what will the signal strength be at 10 meters? Explain how you made your estimate using the inverse square Law.

Ans)

Distance = 5 meters away.
Signal strength = 10^{-5} mW

We know that, in Inverse square law, the signal strength varies inversely with the square of transmission distance.

→ The derivative of signal strength w.r.t distance is n^{-2}.

→ Now that the signal strength is 5m away is
10^{-5} mW

At 'n' meters of distance, we expect

$\boxed{10^{-5} \times (n/5)^{-2} \text{ mW}}$ of signal strength.

In 10 meters, we would expect to have
$10^{-5} \times (10/5)^{-2} \text{ mW} = \frac{1}{10^5} \times \frac{1}{4}$

$= \frac{1}{400000} = \underline{2.5 \times 10^{-6} \text{ mW}}$

(7.) Distance = 20 meters.

Signal strength = 10^{-6} mW.

We know that, in Inverse square law, the signal strength varies inversely with the square of transmission distance.

→ The derivative of signal strength w.r.t distance is n^{-2}.

→ Now that the signal strength is 20m away is
10^{-6} mW.

At 'n' meters of distance, we expect

$\boxed{10^{-6} \times (n/20)^{-2} \text{ mW}}$ of signal strength.

In 5-meters, we would expect to have

$$\Rightarrow 10^{-6} \times \left(\frac{\cancel{5}\,1}{2\cancel{0}_{4}}\right)^{-2} mW = \frac{1}{10^6} \times \frac{4^2}{1} mW$$

$$\Rightarrow \frac{16}{10^6} mW = 1.6 \times 10^{-5} mW = \underline{0.000016 mW}.$$

(8.) Distance $= D$ meters.

Signal strength $= 10^{-6}$ mW.

$\Rightarrow$ At 'n' meters of Distance,

we expect $\boxed{10^{-6} \times \left(\frac{n}{D}\right)^{-2} mW}$ of signal strength.

In terms of D-meter, we would expect to have (Given expected signal strength; i.e 10^{-8})

$$10^{-6} \times \left(\frac{n}{D}\right)^{-2} = 10^{-8} mW$$

$$\left(\frac{n}{D}\right)^{-2} = \frac{10^{-8} \cancel{mW}}{10^{-6} mW}$$

$$\left(\frac{n}{D}\right)^{-2} = 10^{-8+6}$$

$$\left(\frac{n}{D}\right)^{-2} = \underline{10^{-2} \text{ meters}}.$$

verification: $10^{-6} \times \left(\frac{n}{D}\right)^{-2} mW$

$$10^{-6} \times 10^{-2} \ mW = \underline{\underline{10^{-8} \ mW}}.$$

9.

1.) when a Fiber optic cable is used, the cable can't have <u>tight bends</u> as the light will not reach the destination and tends to loose the speed.

2.) Having the Fiber optic connect to all the wifi access points to each other and to the internet causes the network speed to scramble among all that is being shared and eventually the end destination looses the speed.

→ we can test the problem by properly aligning the optic Fiber without any bends and by using a switch for the access points helps increase the end user speed.

10. → project Loon was discontinued because of

unable to find a way to get the costs low enough to build a long-term, sustainable business (High cost to build).

→ The problem is not the idea or technology they had / developed, but couldn't find a way to keep the build cost low and also by not

able to have a certain backup investors for the project.

They could have overcome by having a backup investors, so that they could have been continuing developing to try to make it in less cost.

→ well, I personally think that for now starlink is an effective alternative because

there is no other company that is testing in that field has overcome some huge hurdles other than starlink.

But gradually as the technology keeps getting better, we will find a better way to keep this kind of technology less costlier and more productive.