PATUAKHALI SCIENCE AND TECHNOLOGY UNIVERSITY

COURSE CODE CCE-211

SUBMITTED TO:

Prof. Dr. Md Samsuzzaman

Department of Computer and Communication Engineering

Faculty of Computer Science and Engineering

SUBMITTED BY:

Md. Sadman Kabir

ID: **2102020**,

Registration No: **10147**

Faculty of Computer Science and Engineering

Date of submission: **22, September,2024**

Assignment: Chapter 4

Chapter 4 Review Questions

1. In this chapter, we discussed unipolar, polar, bipolar, multilevel, and multitransitional coding techniques.

2. A self-synchronizing digital signal incorporates timing information within the transmitted data. This is achieved through transitions in the signal that notify the receiver of the start, middle, or end of a pulse.

3. Scrambling, as explained in this chapter, is a technique that replaces long sequences of zero-level pulses with combinations of other levels, without increasing the number of bits.

4. Both PCM and DM use sampling to convert analog signals into digital form. PCM determines the signal amplitude for each sample, while DM tracks changes between consecutive samples.

5. The data rate specifies how many data elements (bits) are sent per second, measured in bits per second (bps). The signal rate, or baud rate, represents how many signal elements are transmitted per second.

6. A data element is the smallest unit that can represent information (a bit), while a signal element is the shortest unit of a digital signal. Data elements are the information we transmit, while signal elements are the means of transmission.

7. In parallel transmission, multiple bits are sent simultaneously, while in serial transmission, data is sent one bit at a time.

8. Block coding introduces redundancy for synchronization and error detection. Typically, block coding converts a block of m bits into a block of n bits, where n is greater than m.

9. The three techniques covered in this chapter are line coding, block coding, and scrambling.

10. We discussed synchronous, asynchronous, and isochronous transmissions. In both synchronous and asynchronous transmissions, the bit stream is divided into frames. In synchronous transmission, the bytes within each frame are synchronized. In asynchronous transmission, the bytes in each frame are independent. Isochronous transmission requires all bits in the stream to be synchronized with no independent frames.

11. A constant voltage level in a digital signal generates low frequencies in the spectrum, referred to as DC components, which can cause issues in systems that cannot handle low frequencies.

12. When decoding a digital signal, the receiver compares the incoming signal power against a baseline (a running average of the received signal power). A long sequence of 0s or 1s may cause baseline wandering, making it difficult for the receiver to decode accurately.

Problems solve:

4.1: In 5B/6B, we have $2^5 = 32$ data sequences and $2^6 = 64$ code sequences. The number of unused code sequences is $64 - 32 = 32$. In 3B/4B, we have 23 = 8 data sequences and $2^4 = 16$ code sequences. The number of unused code sequences is $16 - 8 = 8$.

4.2: The number of bits is calculated as $(0.3 / 100) \times (1 \text{ Mbps}) = 3000$ bits

4.3: The maximum data rate can be calculated as

$N_{max} = 2 \times B \times n_b = 2 \times 200 \text{ KHz} \times \log_2 4 =$ **800 kbps**

4.4:

a. The output stream is 01010 11110 11110 11110 11110 01001.

b. The maximum length of consecutive 0s in the input stream is 19.

c. The maximum length of consecutive 0s in the output stream is 2.

4.5:

a. In a low-pass signal, the minimum frequency 0. Therefore, we have

fmax = 0 + 300 = 300 KHz. → fs = 2 × 300,000 = **600,000 samples/s**

b. In a bandpass signal, the maximum frequency is equal to the minimum frequency plus the bandwidth. Therefore, we have

fmax = 100 + 300 = 400 KHz. → fs = 2 × 400,000 = **800,000 samples /s**

4.6:

a. For synchronous transmission, we have 1200 × 8 = **9600** bits.

b. For asynchronous transmission, we have 1200 × 10 = **12000** bits. Note that we assume only one stop bit and one start bit. Some systems send more start bits.

c. For case a, the redundancy is 0%. For case b, we send 2000 extra for 9600 required bits. The redundancy is **20.833%**.

4.7:

a. NRZ → N = 2 × B = 2 × 2 MHz = 4 Mbps

b. Manchester → N = 1 × B = 1 × 2 MHz = 2 Mbps

c. MLT-3 → N = 3 × B = 3 × 2 MHz = 6 Mbps

d. 2B1Q → N = 4 × B = 4 × 2 MHz = 8 Mbps

4.8:

a. In a lowpass signal, the minimum frequency is 0. Therefore, we can say

fmax = 0 + 300 = 300 KHz → fs = 2 × 300,000 = **600,000 samples/s**

The number of bits per sample and the bit rate are

nb = $\log_2$ 1024= 10 bits/sample N = 600 KHz × 10 **= 6 Mbps**

b. The value of nb = 10. We can easily calculate the value of SNR_{dB}

$$SNR_{dB} = 6.02 \times nb + 1.76 = 61.96$$

c. The value of nb = 10. The minimum bandwidth can be calculated as

$B_{PCM} = nb \times B_{analog} = 10 \times 300\ KHz =$ **3 MHz**

4.9:

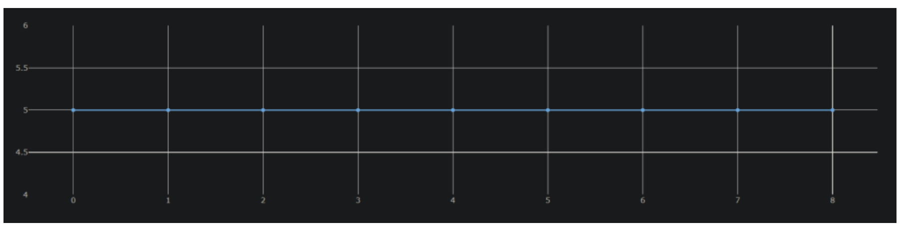
a. NRZ-I: **10011001**.

b. Differential Manchester: **11000100**.

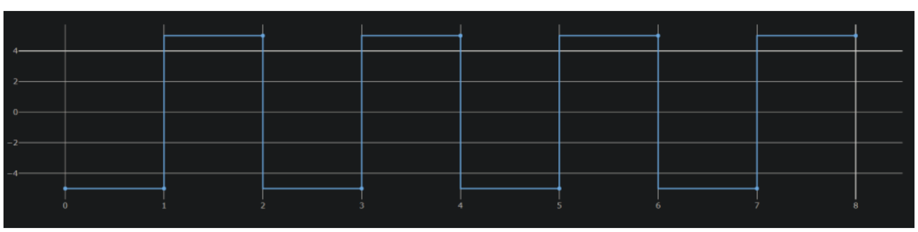
c. AMI: **01110001**.

4.10:

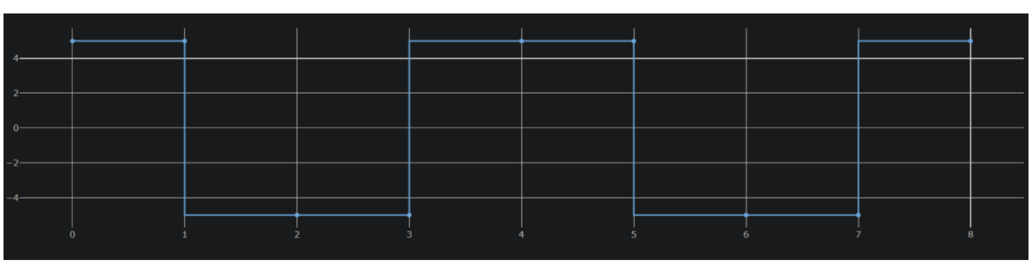
a.00000000



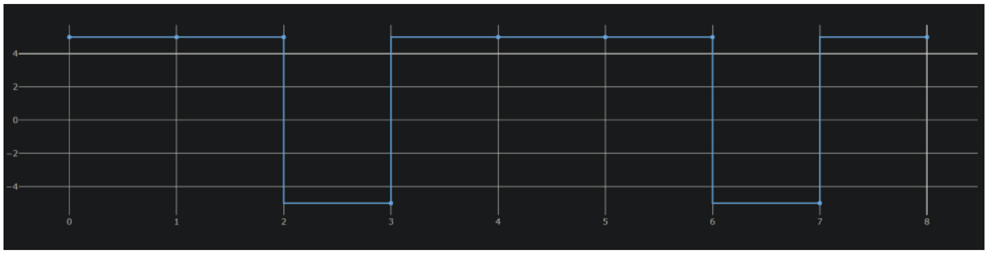
b.11111111



c.01010101



d.00110011



4.11:

a. $r = 1 \rightarrow s = (1/2) \times (1\ \text{Mbps}) \times 1/1 = 500$ kbaud

b. $r = 1/2 \rightarrow s = (1/2) \times (1\ \text{Mbps}) \times 1/(1/2) = 1$ Mbaud

c. $r = 2 \rightarrow s = (1/2) \times (1\ \text{Mbps}) \times 1/2 = 250$ Kbaud

d. $r = 4/3 \rightarrow s = (1/2) \times (1\ \text{Mbps}) \times 1/(4/3) = 375$ Kbaud

4.12:

We can first calculate the sampling rate (fs) and the number of bits per sample (nb)

$f_{max} = 0 + 4 = 4$ KHz $\rightarrow f_s = 2 \times 4 =$ **8000 sample/s**

We then calculate the number of bits per sample.

$\rightarrow nb = 30000 / 8000 = 3.75$

We need to use the next integer nb = 4. The value of SNR_{dB} is

$SNR_{dB} = 6.02 \times nb + 1.72 = 25.8$

4.13:

The data rate is 100 Kbps. For each case, we first need to calculate the value f/N.

We then use Figure 4.8 in the text to find P (energy per Hz). All calculations are

approximations.

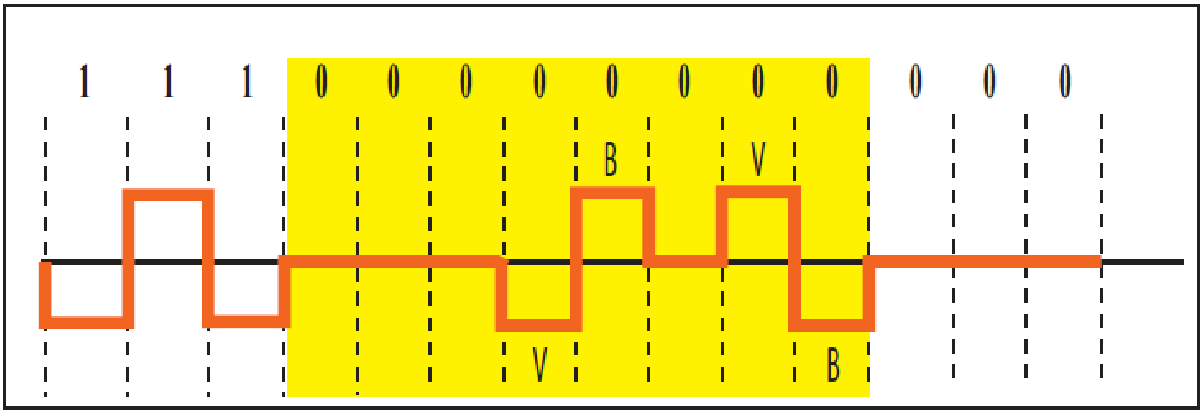
a. $f/N = 0/100 = 0 \rightarrow$ **P = 0.0**

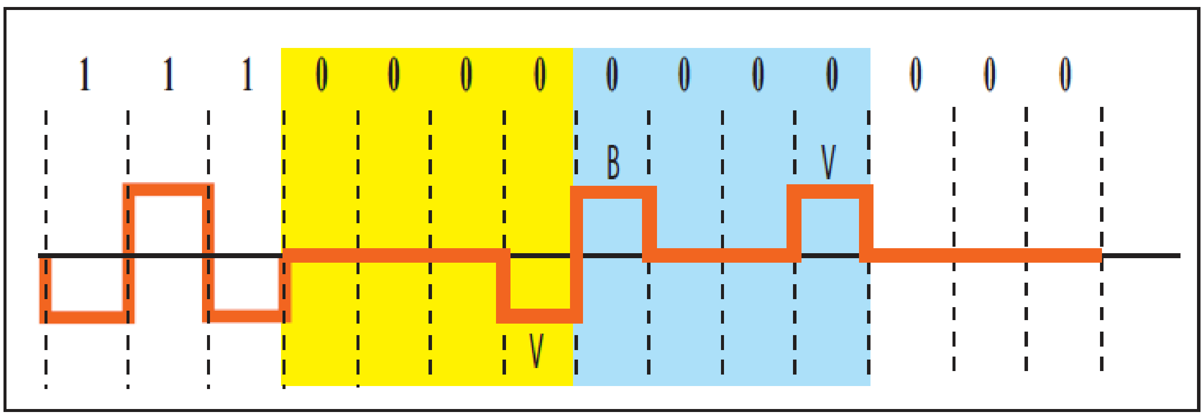
b. $f/N = 50/100 = 1/2 \rightarrow$ **P = 0.3**

c. f /N = 100/100 = 1 → **P = 0.4**

4.14:

a. B8ZS

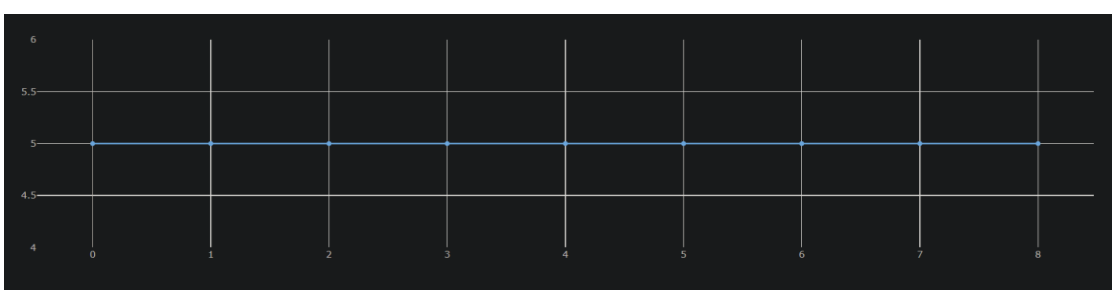




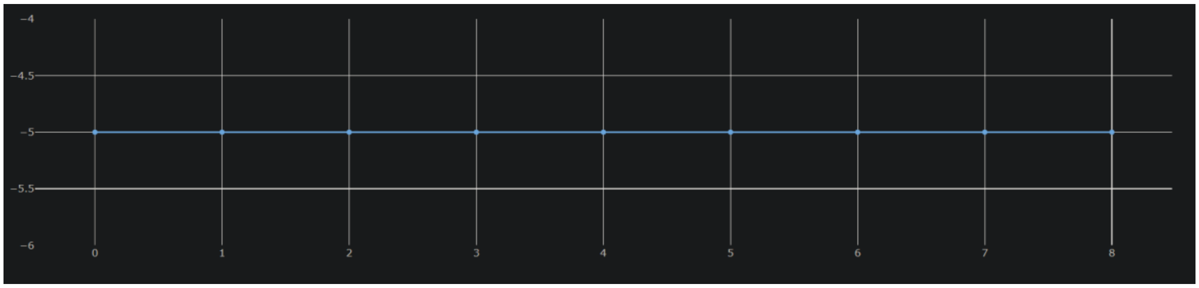
b. HDB3

4.15:

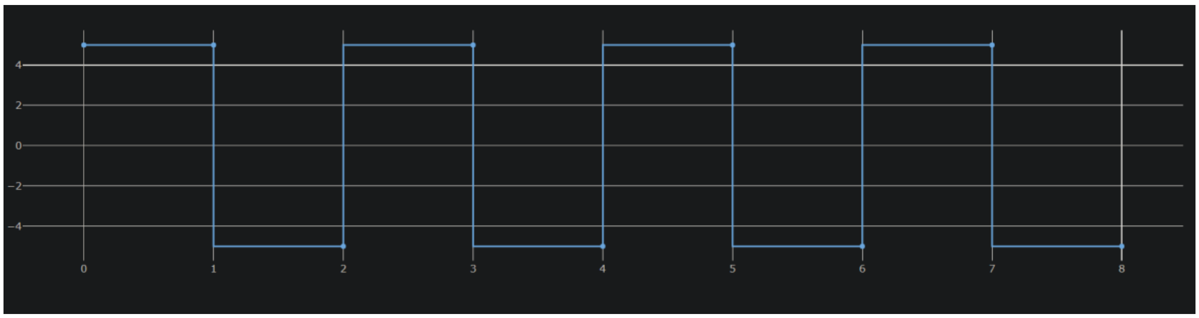
a.00000000



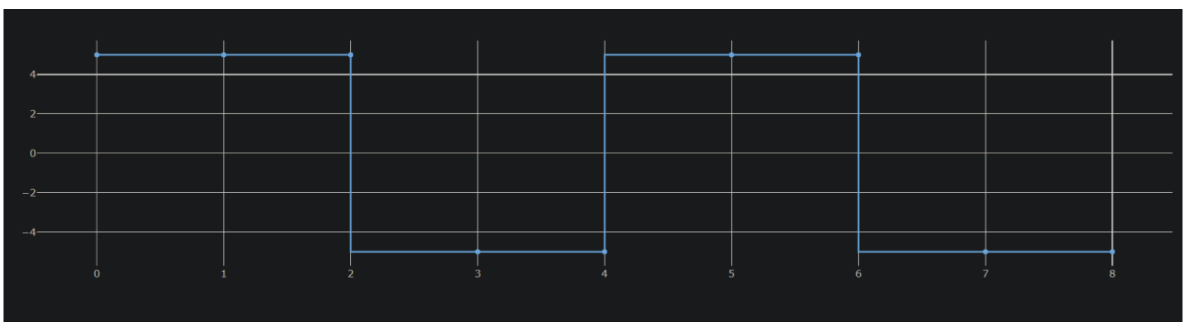
b.11111111



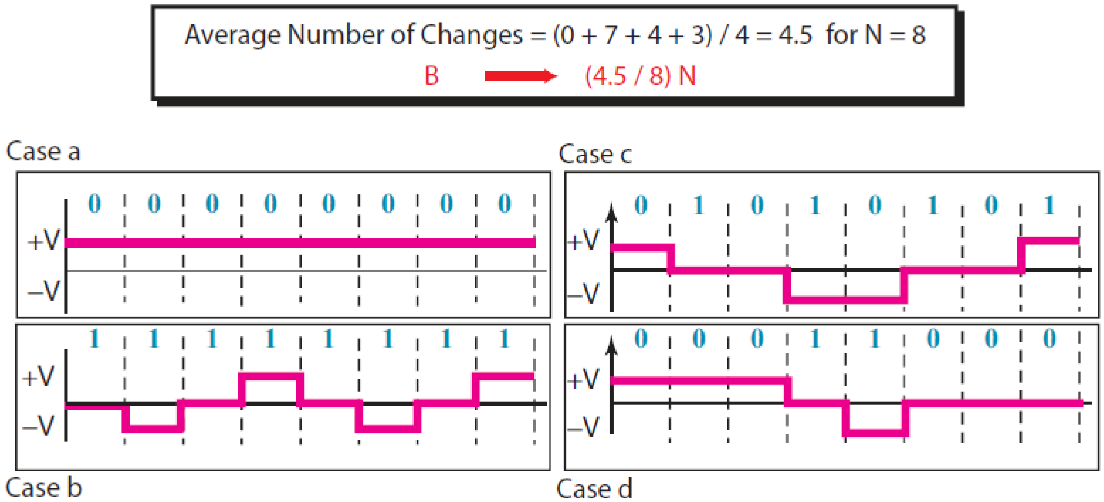
c.01010101



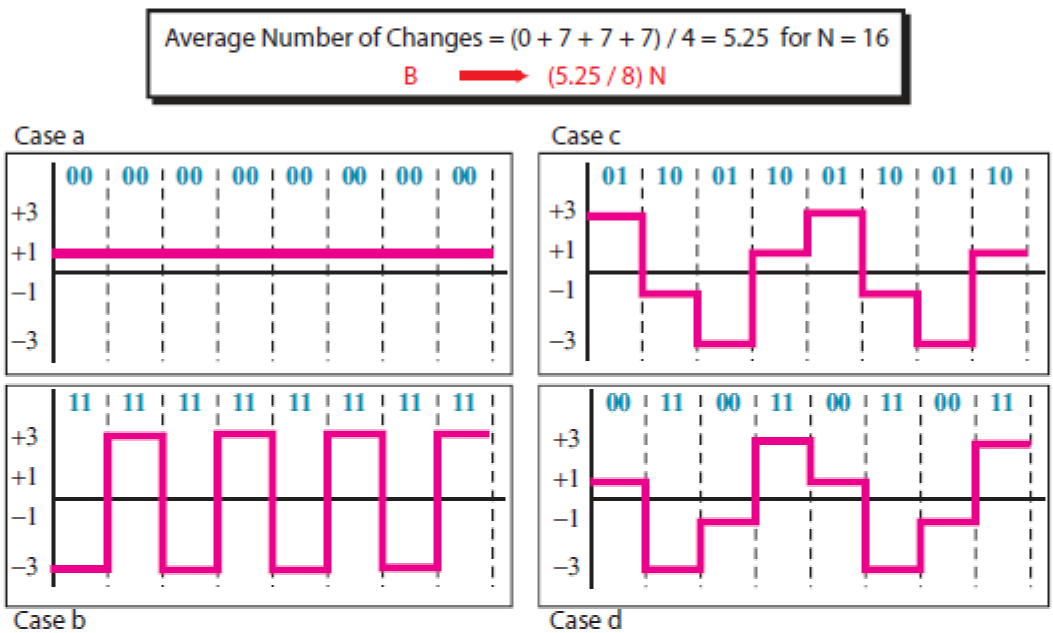
d.00110011



4.16:

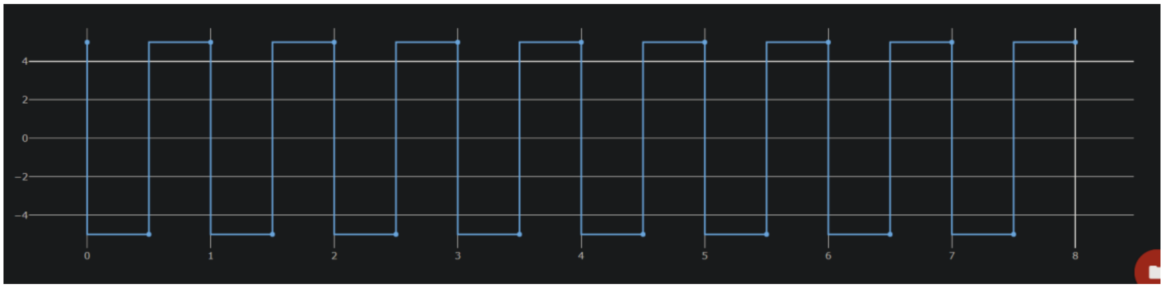


4.17:

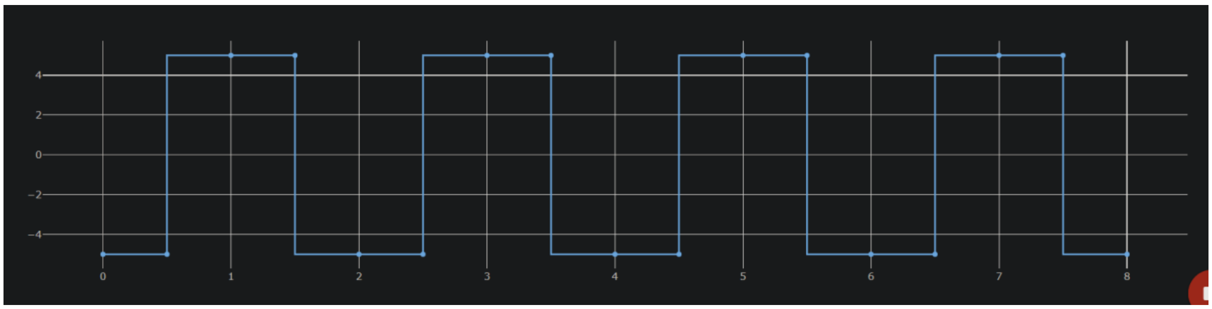


4.18:

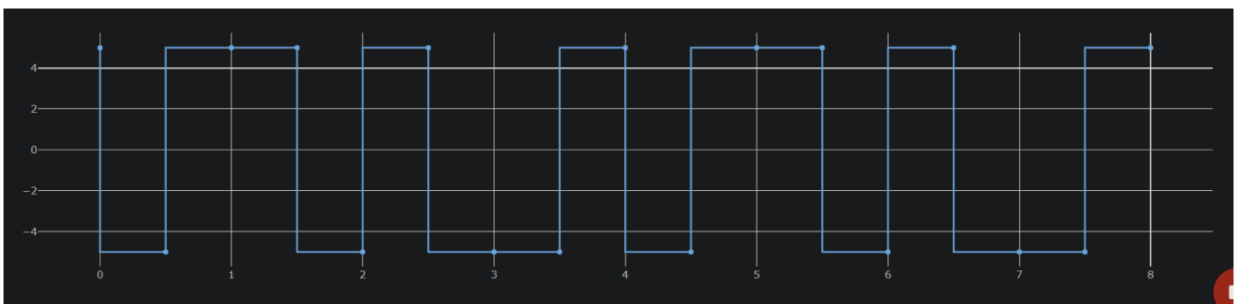
a.00000000



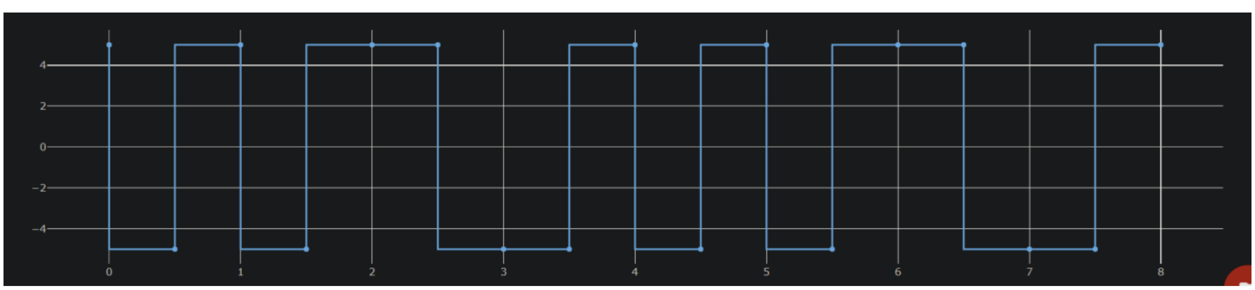
b.11111111



c.01010101

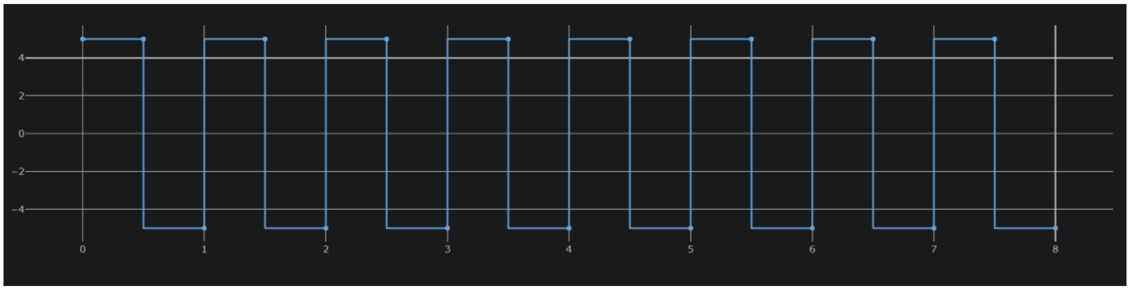


d.00110011

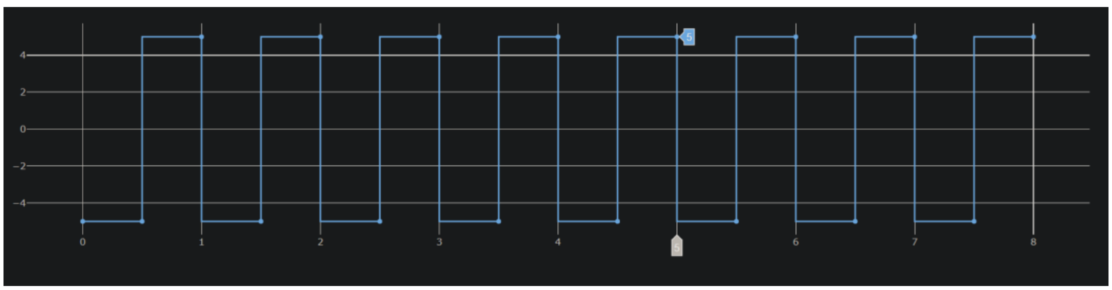


4.19:

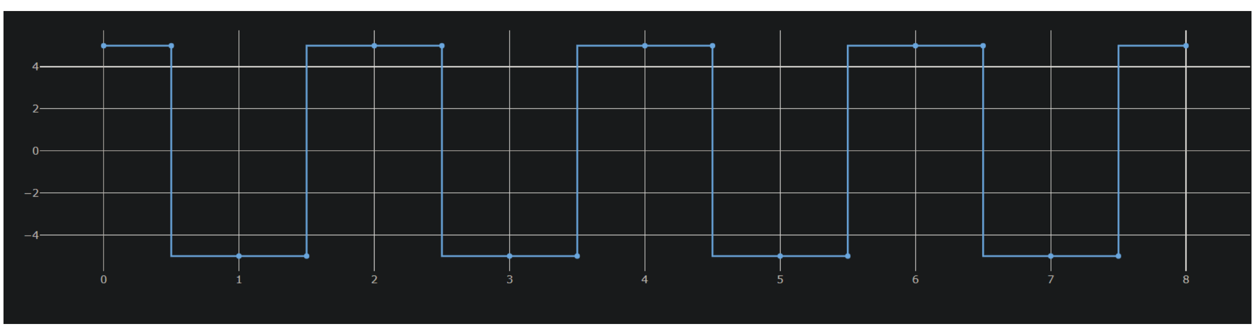
a.00000000



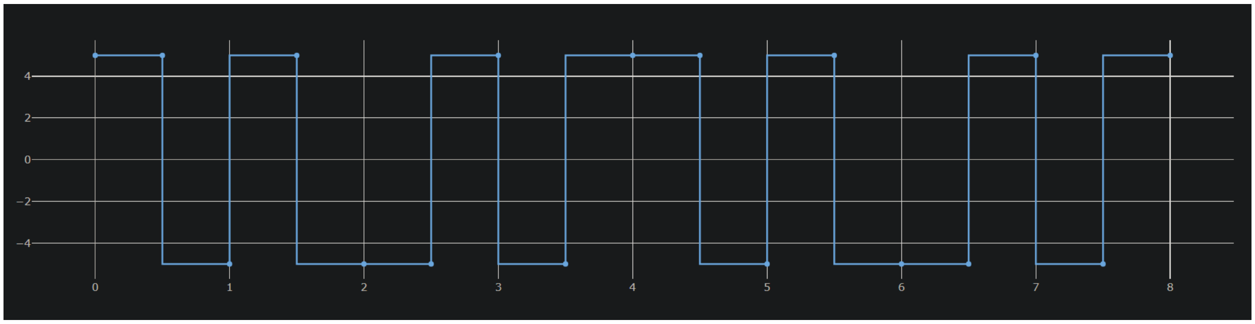
b.11111111



c.01010101



d.00110011



4.20:

a. $f/N = 0/100 = 0 \longrightarrow P = 1.0$

b. $f/N = 50/100 = 1/2 \longrightarrow P = 0.5$

c. $f/N = 100/100 = 1 \longrightarrow P = 0.0$