

Exercise (SS 2022)

Communication Systems and Protocols

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Task 1: Line Codes

1.1 Draw the digital signals for the bit string 101 100 000 011 using each of the NRZ, Manchester, and differential Manchester digital encoding schemes. Use Figure 1.1.

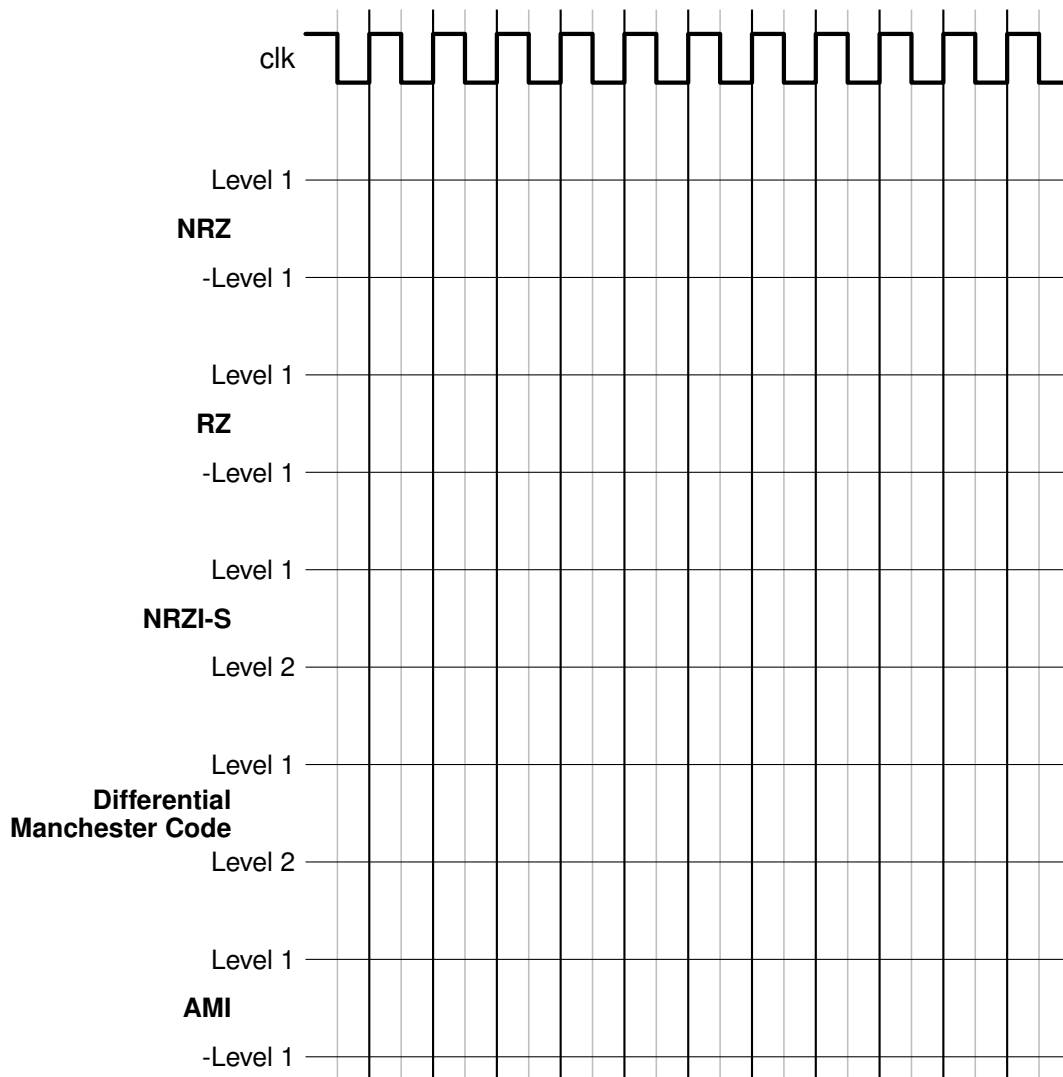


Figure 1.1: Line codes

1.2 Encode the following bit string using the 4B/5B code:

101000001111111000010111

1.3 What is the longest sequence of "0" if the 4B/5B code is used?

1.4 What is the longest sequence of "1" if the 4B/5B code is used?

1

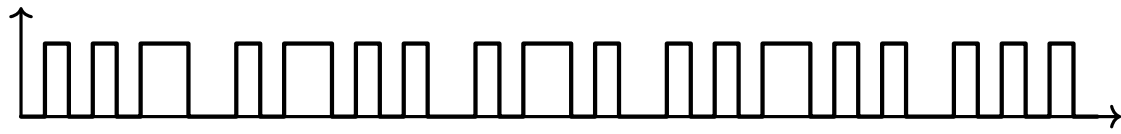
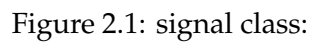


Figure 1.2: Manchester coded bit string

4



4)

Task 3: Channel Capacity

/3

- 3.1 A digital transmission system with a bandwidth of $B = 1,5 * 10^6 \text{ Hz}$ has a channel capacity of $C = 5 \text{ Mbit/s}$ (according to Shannon). What is the minimum for the signal to noise ratio (SNR) in dB?

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Task 4: Code Division Multiple Access (CDMA)

/11

- 4.1 The transmission scheme "Code Division Multiple Access" uses so called spreading codes to separate different transmissions. One group of functions that can be used for this purpose, are the Walsh functions. The CDMA scheme shall be used for simultaneous transmission of eight different messages. Derive the required Walsh functions. /2
- 4.2 Consider now that there are 100 messages to be sent. Here again CDMA scheme shall be used and Walsh table will be used to obtain the spreading codes. What is the number of elements in the spreading code? /1
- 4.3 For the simultaneous transmission of three messages, the Walsh function calculated in this task shall be used. The eight bit given in Table 4.1 shall be encoded each using one of the Walsh functions mentioned in Task 4A. They are the transmitted simultaneously. The Walsh function is to be inverted when a '0' is to be transmitted and remains unchanged for a '1' to be send. Give the resulting signal on the media. Make use of the given scheme. /3

Node	Data	Signal							
0	"1"								
3	"0"								
6	"1"								
Signal on media									

Table 4.1: transmission with CDMA

The following Signal has been received from a transmission using the Walsh functions from this task.

$$+2.1 +1.9 +1.4 +2.0 -1.7 +5.3 -2.1 -1.9$$

As corruptions might happen during transmission, the receiver has a tolerance band for the detection of "1" and "0". All values differing up to ± 0.5 from the ideal value will still be accepted as "1" and "0".

- 4.4 Calculate the bit value based on what the receiver listening to node 1 and 5 detects on the channel. /2
- 4.5 Is it possible to send only two different values (+1,-1) instead of the analog signal? /3