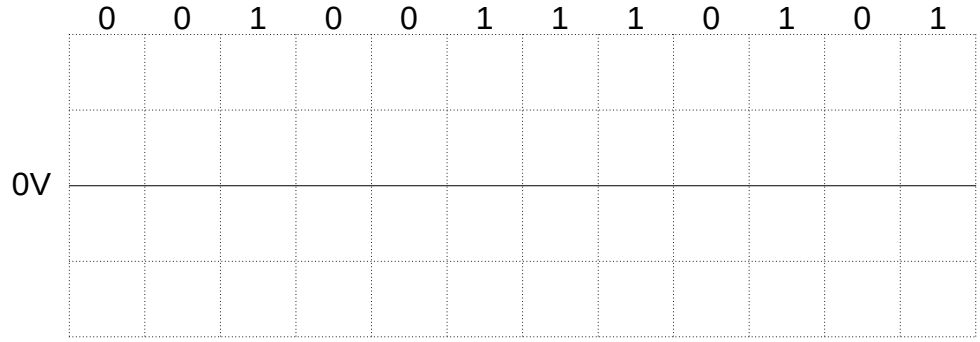
ITS 323 – QUIZ 3 (CS) ANSWERS

First name: _____ Last name: _____

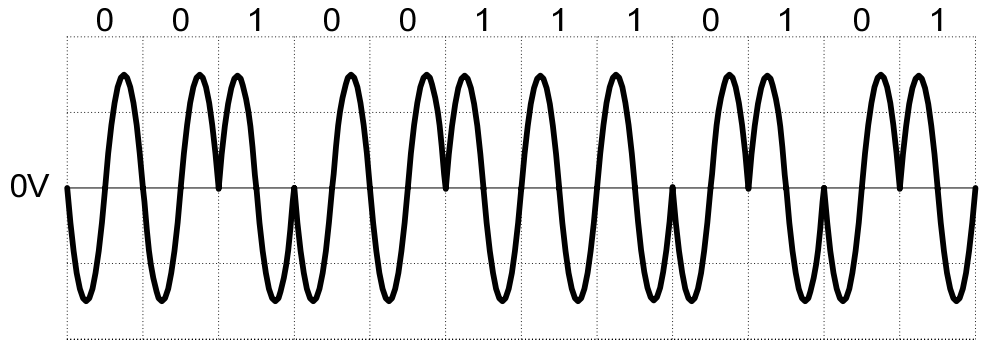
ID: _____ Total Marks: _____
out of 10

Question 1 [2 marks]

Draw the analog signal used to transmit the digital data below if Binary Phase Shift Keying is used.



Answer



Question 2 [2 marks]

A single bit even parity check is added to the front of an 8-bit data frame (01101101). For the following received bits, indicate if the receiver can detect the error or not (circle the answer):

a) 101111101 DETECT NOT DETECT

b) 101110101 DETECT NOT DETECT

c) 001101101 DETECT NOT DETECT

d) 000001101 DETECT NOT DETECT

Answer

a. DETECT (1 error) b. NOT DETECT (2 errors) c. DETECT (1 error) d. DETECT (3 errors)

A single bit parity check can detect an odd number of errors (1 error or 3 errors or 5 errors). It doesn't matter if it is the parity bit that is in error. The treats all 9 bits equally.

Question 3 [4 marks]

An error correcting code maps 2-bits of data into a 4 bit codeword according to the following scheme:

- 00 => 1001
- 01 => 0111
- 10 => 1011
- 11 => 1100

The Hamming distance is used to correct errors.

If the transmitted data is 10, for the following cases, indicate the received codeword and, if relevant, the received data. Also indicate the result at the received by circling one of:

- NO ERROR
- Successfully detected and corrected error (CORRECT)
- Detected, but could not correct (DETECT ONLY)
- Failed to detect or correct error (FAILED)

a) Second bit is in error

Received Codeword: _____ Received Data: _____

NO ERROR CORRECT DETECT FAILED

b) First and second bit are in error

Received Codeword: _____ Received Data: _____

NO ERROR CORRECT DETECT FAILED

c) All bits are in error

Received Codeword: _____ Received Data: _____

NO ERROR CORRECT DETECT FAILED

d) What is the maximum throughput of a link with data rate of 1Mb/s using the above error correction scheme?

Answer

Transmitted codeword: 1011

a. Received codeword: 1111 (invalid). Two codewords have minimum Hamming distance of 1, and hence cannot correct. DETECT

b. Received codeword: 0111 (valid). Received data: 01 FAILED

c. Received codeword: 0100 (invalid). Codeword with min distance is 1100 (distance 1), hence Received Data is 11. FAILED

d. 2 bits are sent as 4 bit codeword, therefore 50% efficiency, therefore throughput is 0.5Mb/s

Question 4 [2 marks]

What is the maximum throughput of the Sliding Window Flow Control protocol with Window Size 3 and if the receiver sends an ACK (or Receive Ready) frame after receiving all frames within the window. [Hint: consider how long it takes to send a window of frames and receive the single ACK]

You can assume:

- Data rate is 1Mb/s
- Data frame size is 10,000 bits
- ACK size is 100 bits
- Propagation time is 10msec
- No processing delay

Answer

The efficiency is time spent sending DATA frames divided by total time spent in transfer. The total time is: time spent sending DATA frames + DATApropagation + ACKpropagation + ACKtransmision

$$Eff = \frac{3 \times DataTransmission}{3 \times DataTransmission + 2 \times \Pr opagation + ACKTransmission}$$

$$= \frac{3 \times \left({}^{10,000}\!\!\diagup\!\!{}_{1,000,000} \right)}{3 \times \left({}^{10,000}\!\!\diagup\!\!{}_{1,000,000} \right) + 2 \times 10ms + {}^{100}\!\!\diagup\!\!{}_{1,000,000}}$$

$$= \frac{30}{30 + 20 + 0.1} ms$$

$$= 0.6$$

Therefore throughput is 0.6 x 1Mb/s = 0.6Mb/s