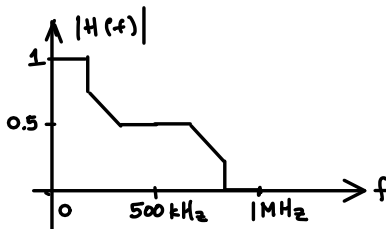


Assignment 3

Due Tuesday, April 8. Show your work. Hand in your assignment using the appropriate dropbox on the course web site. Assignments submitted after the solutions are made available will be given a mark of zero.

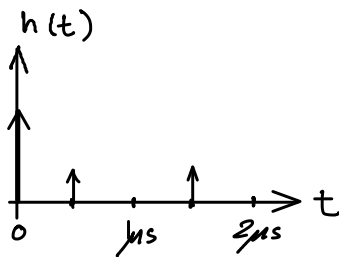
Question 1

Will a signal transmitted at a symbol rate of 1 MHz over a channel with the following frequency response be distorted? Will there be interference between the symbols?



Question 2

Will a signal transmitted at a symbol rate of 2 MHz over a channel with the following impulse response have ISI? Does the channel meet the Nyquist conditions for no ISI for a symbol rate of 1 MHz?



Question 3

A signal with a power of 100 mW is transmitted over a channel with a 1 MHz bandwidth and has noise with a power of 10 mW added to it. What is the maximum error-free data rate if the noise consists of impulses 1 μs long every 1 ms? What is the maximum error-free data rate if the noise is additive white Gaussian noise (AWGN)?

Question 4

A 4-level signal with a symbol rate of 10 MHz is transmitted over a channel with a 2.5 MHz bandwidth. The channel has no noise. Can the transmitted levels be recovered at the receiver? If so, how?

Question 5

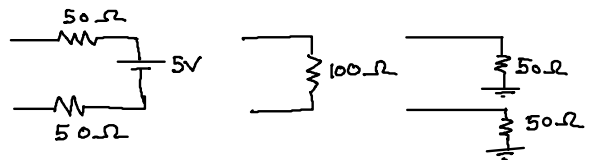
An OFDM system has a subcarrier spacing of 4 kHz and uses 256 samples per symbol. What is the sampling rate? If the duration of ISI is 3 μs, what is the minimum length of the cyclic extension (in samples)?

Question 6

Why might a security alarm system use a current loop to monitor a sensor?

Question 7

Which of the following would provide the best termination for a signal being transmitted differentially over 100 Ω UTP using bipolar NRZ signalling with levels of ±5V (voltage measured differentially)? Why?



Question 8

Would a typical line driver (T/F):

- (a) provide impedance matching?

- (b) detect parity errors?
- (c) provide a logic-level output?
- (d) provide a logic-level input?

Question 9

You would like to provide protection against high (power line) voltages to a data link that operates over co-ax cable. The line driver has a differential output but the receiver is single-ended (the receiver's input is referenced to ground). You would also like to establish a DC path for powering the remote end over the co-ax cable. Draw a schematic showing how this could be achieved.

Question 10

Draw the waveform that would be transmitted if the following bit sequence were transmitted using Manchester and differential Manchester line codes. If necessary, assume the previous input bits were all zero.

1 0 0 1 1 0

Question 11

Of the following line codes: Manchester, AMI, NRZ, and differential RZ:

- (a) which has/have the minimum number of guaranteed signal level transitions per bit?
- (b) which has/have the maximum number of guaranteed signal level transitions per bit?
- (c) which has/have the minimum number of signal levels?

Question 12

Use HDLC encoding to frame the following sequence of bits:

1 0 1 1 0 1 1 1 1 1 1 1 0 1

including start and end flag sequences.

Question 13

Assuming an ASCII STX character (0x02) was to be used to indicate the start of a frame, an ETX character (0x03) the end of a frame and ESC (0x1B) to escape framing and escape characters, how would the following sequence of characters be framed (values given in hex)?

00 01 03 51 2A 1B 10 02 11

Question 14

A 16-QAM (4 bits/symbol) transmitter is used to transmit a frame of 1795 bits. How many symbols will have to be sent? How many bits will be sent in total? How many padding bits?