

Assignment 3

Due Wednesday, April 12. Show your work. Submit 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

A system using differential signalling is affected by common-mode 60 Hz sinusoidal interference from power lines. The receiver recovers the differential signal by subtracting the two received signals. Component tolerances in the receiver introduce a time delay of 1 ms between the two received signals.

What is the amplitude and frequency of the interference at the output of the differential receiver?

Hint:

Consider that the received interference signals are $u(t) = \sin(2\pi ft)$ and $v(t) = \sin(2\pi f(t - \tau))$ where $f = 60$ Hz and $\tau = 10^{-3}$ s. The receiver's differential output is $u - v$.

You may want to use the identity:

$$\sin u - \sin v = 2 \cos \left(\frac{u + v}{2} \right) \sin \left(\frac{u - v}{2} \right)$$

Question 2

- A communication system operates over a 200 kHz channel with an SNR of 21 dB. What is maximum bit rate you could expect to communicate over this channel assuming the data was already compressed as much as possible?
- If the channel was low-pass, what is the maximum symbol rate you could transmit over this channel without experiencing ISI?
- Why are the two numbers different?

Question 3

Assuming the data to be PPP encapsulated is completely random, what is the percentage overhead added by the insertion of PPP escape characters? Ignore all other overhead (e.g. start and end of a frame

bytes, headers, etc). Explain how you arrived at your answer.

Question 4

Consider a block code consisting of symbols from GF(4) represented by the letters A through D. The code consists of the following valid codewords:

ABCD
BCDA
CDAB
DABC

- What is the minimum distance of this code? How many (symbol) errors in each codeword can be detected? How many can be corrected?
- If the symbol ADAD is received, did the channel introduce an error? If so, can the error be corrected? If so, what was the transmitted symbol?
- If the symbol DAAC is received, did the channel introduce an error? If so, can the error be corrected? If so, what was the transmitted symbol?

Question 5

The following bytes (in hexadecimal) are the contents of an Ethernet frame header (not including preamble):

00 1d 7e 2f b5 9b 00 24 1d 73 df ce 08 00

- What is the destination address? What is the OUI of the destination interface?
- What is the source address? What is the OUI of the source interface?
- What is the value of the length/type field in decimal? Is this a length or a type value?