

## CS 346 Fall 2017 – Assignment #2

### Deadlines

This assignment is due on **Tuesday, September 19, 2017 @ 5:00 PM (the beginning of class)**.

### How to submit your work on the assignment:

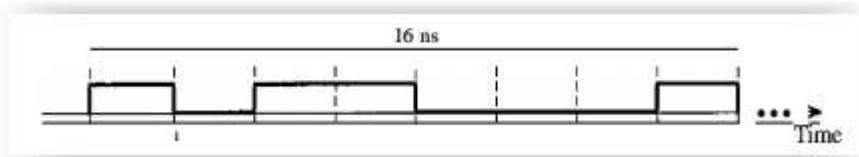
Your assignment work will be accepted in paper form, or you can submit it online.

**NEW ONLINE SUBMISSION INSTRUCTIONS:** Online submission of this assignment will be done via Canvas. Do NOT send your submission by email. Only PDF documents will be accepted, and NO scanned PDFs!

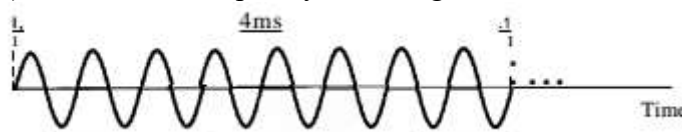
**NO MIXED SUBMISSIONS!** Submit the assignment as one document: either all on paper, or all online.

**Note:** Due to equations, graphs, figures, and special symbols often required in assignment problems, using a word processor may end up taking much more time and effort. I recommend that if an assignment requires such components, then those elements can be hand-drawn and the entire assignment submitted on paper.

1. (Problem P2-13, p. 49) In an internet, we change the LAN technology to a new one. Which layers in the TCP/IP protocol stack need to be changed?
2. (Problem P3-1 (all parts), p. 91) Given the frequencies, calculate the corresponding periods.  
(a) 24 Hz                      (b) 8 MHz                      (c) 140 KHz
3. (Problem P3-2 (all parts), p. 91) Given the periods, calculate the corresponding frequencies.  
(a) 5 sec                      (b) 12  $\mu$ sec                      (c) 220 nsec
4. (Problem P3-7 (all parts), p. 91) What is the bit rate for each of the following signals?  
(a) A signal in which each 1 bit lasts 0.001 sec  
(b) A signal in which each 1 bit lasts 2 msec  
(c) A signal in which each 10 bits lasts 20  $\mu$ sec
5. (Problem P3-9, p. 92) What is the bit rate for the signal in the following figure?



6. (Problem P3-10, p. 92) What is the frequency of the signal in the following figure?



CONTINUED ON THE NEXT PAGE!

7. (Problem P3-16, p. 92) The attenuation of a signal is  $-10$  dB. What is the final signal power if it was originally 5 Watts? (Express your answer in the appropriate units in Engineering Notation)
8. (Problem P3-21, p. 93) A line has a signal-to-noise ratio of 1000 and a bandwidth of 4000 KHz. What is the maximum data rate supported by this line? Use the appropriate formula.
9. (Problem P3-23, p. 93) A file contains 2 million bytes. How long does it take to download this file using a 56 Kbps channel? How long does it take to download this file using a 1 Mbps channel? (You may ignore the overhead for using a file transfer protocol, and assume 8 bits = 1 byte.)
10. (Problem P3-27 (all parts), p. 93) What is the theoretical capacity of a channel in each of the following cases:
  - a) Bandwidth = 20 KHz,  $\text{SNR}_{\text{dB}} = 40$  dB
  - b) Bandwidth = 200 KHz,  $\text{SNR}_{\text{dB}} = 4$  dB
  - c) Bandwidth = 1 MHz,  $\text{SNR}_{\text{dB}} = 20$  dB

Use the formulas for the relationships between frequency, period, wavelength, data rate, bandwidth, bits-per-signal ratio and signal levels, as presented in the text and discussed in class and lab, to compute the following. Show the formula(s) you use and the math needed to calculate the answers!

11. A digital signal that can transmit 18 Mbps using a simple NRZ-L encoding requires what minimum base analog frequency to generate and transmit the "square wave" of the signal? (Give only the base frequency, not the odd-multiple harmonic frequencies that are used to build the square wave.)
12. If a signal has a power of 40 milliwatts (mW) and the signal's noise is only 4 microwatts ( $\mu\text{W}$ ):
  - a) What is the signal/noise ratio (SNR)?
  - b) What is the SNR in decibels?
13. What ratio of bits per signal does a 100 MBaud signal require in order to handle a bit rate of at least 350 Mbps? (Keep in mind, there's no such thing as a fraction of a bit!)  
Using that answer, how many signal levels does such a signal require?
14. Suppose a signal/noise ratio is measured at 60 decibels (that is,  $\text{SNR}_{\text{dB}} = 60$  dB).
  - a) What is the signal to noise ratio ( $\text{SNR} = ?$ ) ?
  - b) If that is the SNR of a 12.5 MHz bandwidth channel, what is the theoretical Shannon capacity of the channel?
15. Identify whether each of the following is a baseband or broadband transmission:
  - a) A 100Base-T Ethernet connection
  - b) A TV channel received over the air
  - c) A point-to-point microwave link
  - d) A face-to-face conversation
16. Name three different types of impairments of a data signal transmission, and state whether you think a digital signal or an analog signal is likely to be more adversely affected by each type of impairment.