Assignment 1
Computer Networks

Due date: 23rd February 2023

1. Suppose that the spectrum of a channel is between 3 MHz and 4 MH and SNR_{dB} = 24dB. Find the channel capacity. How many signal levels are required to achieve this capacity?

2. Consider two periodic functions $f_1(t)$ and $f_2(t)$, with periods T_1 and T_2, respectively. Is it always the case that the function $f(t) = f_1(t) + f_2(t)$ is periodic? If so, demonstrate this fact. If not, under what conditions is f(t) periodic?

3. Consider a channel with 1-MHz capacity and SNR of 63.

a. What is the upper limit to the data rate that channel can carry?

b. The result of part (a) is the upper limit. However, as a practical matter, better error performance will be achieved at a lower data rate. Assume we chose a data rate of 2/3 rd of the maximum theoretical limit. How many signal levels are needed to achieve this data rate?

4. A digital signalling system is required to operate at 9600 bps.

a. If a signal element encodes a 4-bit word, what is the minimum required bandwidth of the channel?

b. Repeat part (a) for the case of 8-bit word.

5. Write a program (in any language you are comfortable) to represent the binary bit sequence into its equivalent digital signal encoding formats for

a. NRZ-L b. NRZ-I c) Bi-polar AMI d) Manchester

6. Consider an audio signal with spectral components in the range 300 to 3000Hz. Assume that a sampling rate of 7000 samples per second will be used to generate a PCM signal

a. For SNR = 30dB, what is the number of uniform quantization levels required?

b. What data rate is required?

7. Two communicating devices are using a single-bit even parity check for error detection. The transmitter sends the byte 10101010 and, because of channel noise, the receiver gets the byte 10011010. Will the receiver detect the error? Why or why not?

8. In a CRC error-detecting scheme, choose $G(x) = x^4 + x + 1$. Encode the bits 10010011011. Suppose the channel introduces an error pattern 100010000000000. What is received? Can the error be detected?