

CSE 425A: Computer Networks

Homework 1 (100 points)

Due: 31.01.2022

The goals of this homework are to develop an understanding a communications model, data communications, networks, protocol architecture as well as the basic concepts of data transmissions, data rate, bandwidth and channel capacity.

1. Draw the simple model of communications illustrated and give an example for each block.
2. Briefly explain the advantages and disadvantages of using layered architecture in computer networks.
3. Find the period of the function $f(t) = (10\cos t)^2$.
4. Draw the spectrum of the signal $s(t) = 4\sin(2\pi t) + 2\sin(6\pi t) + \left(8/\pi\right)\sin(7\pi t)$. Also identify the absolute and effective bandwidths.
5. What is the channel capacity for a teleprinter channel with a 300-Hz bandwidth and a signal-to-noise ratio of 3 dB, where the noise is a white thermal noise?
6. A digital signaling system is required to operate at 9600 bps. If the signal encodes a 4-bit word, what is the minimum required bandwidth of that channel?
7. What is the thermal noise level of a channel with a bandwidth of 10 kHz carrying 1000 watts of power operating at 50°C?
8. The waveform $\sin(2\pi f_1 t) + 1/3 \sin(2\pi(3f_1)t) + 1/5 \sin(2\pi(5f_1)t) + 1/7 \sin(2\pi(7f_1)t)$, with $T = 1$ ms, is passed through a low-pass filter that passes frequencies upto 8 kHz with no attenuation.
 - a. Find the power of the output waveform.
 - b. Assuming that at the filter input there is a thermal noise voltage with $N_0 = 0.1 \mu\text{W/Hz}$, find the output signal to noise ratio in dB.
9. If an amplifier has a 30-dB voltage gain, what voltage ratio does the gain represent?