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CS 3590 Data Communications & Networking
Assignment #2
Fall 2015

REVIEW QUESTIONS:

Q.1. Review Question #3.6
Define fundamental frequency

A frequency which is multiplied by an integer coefficient is known as a fundamental frequency.

Q.2. Review Question #3.7
What is the relationship between the wavelength and the frequency of a sine wave?

Wavelength is the distance taken up by the completion of a single sine wave, and frequency is the rate at which a signal repeats. The shorter the wavelength, the faster the frequency. Correspondingly, the longer the wavelength, the slower the frequency.

Q.3. Review Question #3.8
What is attenuation?

Attenuation is the reduction of strength across a transmission medium.

Q.4. Review Question #3.9
Define channel capacity

Channel capacity is the maximum rate at which data may be transmitted over a communication path, and is determined by specific conditions.

PROBLEM QUESTIONS

Q.5. A periodic composite signal contains frequencies from 10 to 30 KHz, each with an amplitude of 10 V. Draw the frequency spectrum.

Q.6. 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?

4,000,000Hz * (log(1 + 1000) / log(2)) = 39,868,905 bps

Q.7.

a. **Suppose that a digitized TV picture is to be transmitted from a source that uses a matrix of 480 x 500 picture elements (pixels), where each pixel can take on one of 32 intensity values. Assume that 30 pictures are sent per second. (This digital source is roughly equivalent to broadcast TV standards that have been adopted.) Find the source rate R (bps)**

b. **Assume that the TV picture is to be transmitted over a channel with 4.5 MHz bandwidth and a 35 dB signal-to-noise ratio. Find the capacity of the channel (bps).**

   SNR in 35 dB ≅ 3163
   4,500,000 * (log(1 + 3163) / log(2)) = 52,323,902 bps

c. **Discuss how the parameters given in part (a) could be modified to allow transmission of color TV signals without increasing the required value for R.**

Q.8. Consider a channel with a 1-MHz capacity and an SNR of 63.
a. What is the upper limit to the data rate that the 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 choose a data rate of 2/3 the maximum theoretical limit. How many signal levels are needed to achieve this data rate?