KFUPM - COMPUTER ENGINEERING DEPARTMENT

COE-341 – Data and Computer Communication

Assignment 2 – Due date: March 26th, 2012

Student Name:
Student Number:

Problem #	Maximum Mark	Mark
1	30	
2	10	
3	10	
4	10	
5	10	
6	20	
Total	90	

Problem 1 (30 points) Answer the following questions:

a) Define the term "channel capacity" and specify how capacity is computed? What are the key factors that affect channel capacity?

b) What two functions are performed by the antenna? And what determines the antenna gain?

c) In the context of radio frequency propagation what is refraction? And what is the difference between diffraction and scattering?

Problem 2 (10 points)

Consider the following signal $s(t) = (1 + 0.1\cos(5t))\cos(100t)$.

a) (10 points) Decompose $s(t)$ into a linear combination of sinusoidal functions and find the amplitude, frequency, and phase of each component.

b) (bonus 5 points) Find the period (or frequency) of $s(t)$

c) (bonus 5 points) Find the total power for $s(t)$.

Hint: Use the identity $\cos(a)\cos(b) = \frac{1}{2}[\cos(a-b) + \cos(a+b)]$

Problem 3 (10 points)

A digital signaling system is required to operate at 9600 b/s.

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 words.

Problem 4 (10 points)

The square waveform of Figure 3.7c, with T = 1 msec, is passed through a lowpass filter that passes frequencies up to 8 kHz with no attenuation.

a) Find the power in the output waveform.

b) Assuming that at the filter input there is a thermal noise voltage with N0 = 0.1 micro Watts/Hz, find the output signal to noise ratio in dB.

Problem 5 (10 points)

The audio power of the human voice is concentrated at about 300 Hz. Antennas of the appropriate size for this frequency are impractically large, so that to send voice by radio the voice signal must be used to modulate a higher (carrier) frequency for which the natural antenna size is smaller.

a) What is the length of an antenna one-half wavelength long for sending radio at 300 Hz.

b) An alternative is to use a modulation scheme, as described in chapter 5 of textbook, for transmitting the voice signal by modulating a carrier frequency, so that the bandwidth of the signal is a narrow band centered on the carrier frequency. Suppose we would like a half-wave antenna to have a length of 1 meter. What carrier frequency would we use?

Problem 6 (20 points)

A microwave transmitter has an output of 0.1 W at 2 GHz. Assume that this transmitter is used in a microwave communication system where the transmitting and receiving antennas are parabolas, each 1.2 m in diameter.

a) What is the gain of each antenna in decibels?

b) Taking into account antenna gain, what is the effective radiated power of the transmitted signal?

c) If the receiving antenna is located 24 km from the transmitting antenna over a free space path, find the available signal power out of the receiving antenna in dBm units.