ELC 341 HOME WORK SHEET I

1. Draw a schematic diagram of a simplex (one-way) battery operated telephone communications system using a microphone in series with a battery at one end, connected to a pair of telephone wires whose other end is connected to a telephone receiver. Make the following assumptions: The microphone resistance varies from 5 to 500 ohms as the impinging sound pressure changes from its maximum to its minimum value; the telephone receiver at the distant end has a 160-ohm resistive impedance; the battery is 12 volts with negligible internal resistance; the telephone pair has a resistance of 4 ohms per 1000 feet.

a) How far could you talk with this system if you need to produce a 2.5 volt excursion at the receiver?
b) What will be the magnitudes of the maximum and minimum voltages at the receiver?
c) Discuss the limitations on transmission #1. Express you answer in quantitative form (equations).
d) Write a Matlab program to provide a general solution to the above problem. Consider all possible cases. Show how you can you it to design a telephone system.

2. The telephone company transmits audio frequencies from about 100 Hz to 3 kHz.

a) How many simultaneous conversations could you transmit over a twisted pair of wires having a bandwidth of approximately 10 MHz?
b) Do you need guard bands? If so how much? Justify your answer?
c) Draw a diagram of your solution
d) What is the advantage of using an optical fiber rather than wires?

3. a) How wide is the AM Broadcast band in MHz and how many stations can use it?
b) How wide is the FM Broadcast band and how many stations can use it?
c) Where is your nearest radio transmitter located?
d) Compare the information capacity of the AM broadcast signal with an FM broadcast signal. (Hint: What are the channel bandwidths?)
e) How does SNR affect information capacity? (Hint: plot information capacity vs. SNR).

4. A 3D Printer can produce an object with maximum size of 9 cm x 9 cm x 9 cm, and has a resolution of 0.05 cm (step size).

a) What is the maximum information needed to describe an object? (Explain your answer.)
b) If each surface point could have a different color, (assume it is limited to Red, Yellow, Green, Blue, black and white), what is the information needed?

c) Can you suggest ways the amount of information needed to describe an object could be reduced (or *compressed*).

5. TV was invented and first demonstrated in about 1883, not long after the telephone was invented.

a) Design a ***simple*** TV system. You can use photo resistor(s), light bulb(s), switch(es), etc. Show a schematic diagram of your system.
b) Upon what parameters dose the bandwidth of your system depend?
c) What is your system's information rate?
d) What is the approximate information rate of a broadcast TV signal?

6. a) What is the difference between analog and digital transmission?
b) Why is digital the dominant means of communication today?