# CNT 4104-85726: Introduction to Data Communications

**Fall 2010** **Name: _____**

**Midterm** **Last 5 digits of ZN**: Zxxx __ __ __ __ __

This is a CLOSED books/notes test. You are NOT allowed to consult any material you have brought into the classroom. NO exchange of information is allowed among students. Write your name and Z# on each sheet detached.

1. A communication system uses the telephone network as its medium. If a sampling rate of 8000 samples per second is used to generate PCM signals, then for SNR = 30 dB,

   a. What is the number of uniform quantization levels required? Show work. (6 pts.)

   b. What will be the data rate? Show work. (6 pts.)

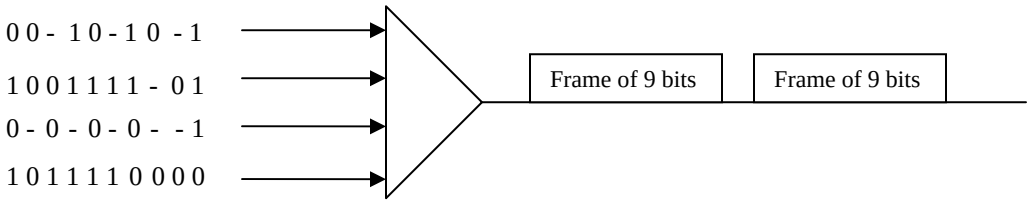
2. What is the channel capacity for a printer channel with a 3K Hz bandwidth and a *signal-to-noise* ratio of 5 dB? Show work. (12 pts.)

3. Four data sources are multiplexed using TDM. Each source produces 2000 characters per second. Assume byte interleaving with 1 bit per frame for synchronization.

   a. What is the frame rate? Show work. (6 pts.)

   b. What is the bit rate on the path? Show work. (6 pts.)

4. The following figure shows a multiplexer in a synchronous TDM system. Each output slot is only 9 bits long (2 bits taken from each input plus 1 framing bit). The bits arrive at the multiplexer as shown below. Draw a diagram to show what the output stream is like for the following given input. (12 pts.)

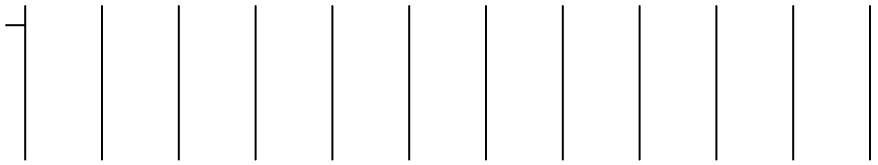


5. Briefly describe Frequency Hopping Spread Spectrum. (12 pts.)

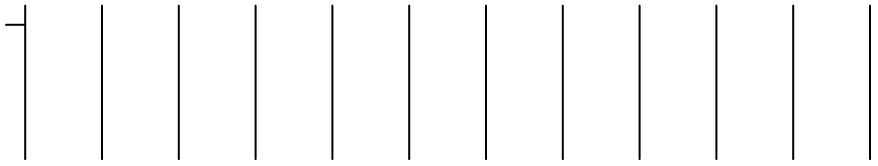
6. Briefly describe Asynchronous, Synchronous, and Isochronous transmissions. (12 pts.)

7. For the bit stream 1 1 0 0 0 0 0 0 0 0 1, sketch the waveforms for each of the following code: (7 pts. Each)

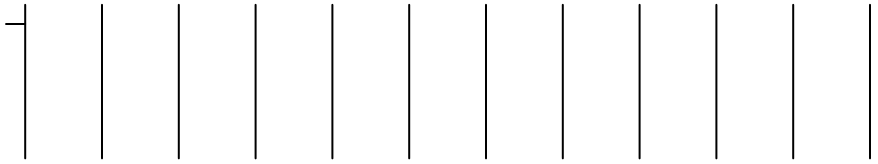
a. NRZ-I



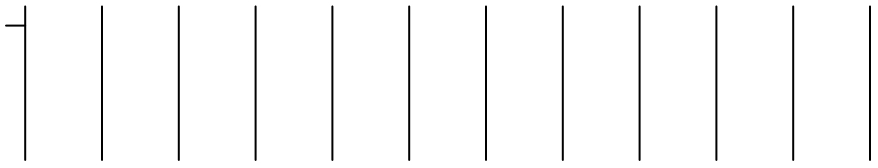
b. Bipolar AMI



c. Differential Manchester



d. B8ZS



**Formula Sheet**

1. SNR = signal power / noise power

2. $\text{SNR}_{\text{dB}} = 10 \log_{10} \text{SNR}$

3. $\text{dB} = 10 \log_{10} (P_2 / P_1)$

4. $\text{BitRate} = 2 * \text{bandwidth} * \log_2 L$

5. $\text{Capacity} = \text{bandwidth} * \log_2 (1 + \text{SNR})$

6. $\text{SNR}_{\text{dB}} = 6.02 n_b + 1.76$

7. NRZ-I

   0 = no transition at beginning of interval (one bit time)
   1 = transition at beginning of interval

8. Bipolar AMI

   0 = no line signal
   1 = positive or negative level, alternating for successive ones

9. Manchester

   0 = transition from positive to negative in middle of interval
   1 = transition from negative to positive in middle of interval

10. Differential Manchester

    Always a transition in middle of interval.

    0 = transition at beginning of interval
    1 = no transition at beginning of interval

11. Bipolar with 8-zeros substitution (B8ZS)

    Same as Bipolar AMI, except that any string of eight zeros is replaced by a string with two code violations:

| Polarity of preceding pulse | If an octet of all zeros occurs the new bit string will be: |
|---|---|
| - | 0 0 0 - + 0 + - |
| + | 0 0 0 + - 0 - + |