Directions: Answer all questions in the space provided. One 8.5 by 11 inch notes page permitted.

No talking. Closed book. Show your work.

1. a) What is the OSI?

   b) What are its layers?

   c) What are their functions?

2. a) What is the spectrum of a continuous signal?

   b) What is its relevance to digital encoding?

   c) What is interlacing in TV signals? Why do it?

3. a) Suppose the spectral efficiency of a ground wave system is 2 bits per Hertz. With a communication
      band of 100 to 400 Hz, what is the data rate possible?

   b) How many distinct signal elements must be used for this rate?

   c) Assuming that the Shannon limit can be reached, what is the minimum SNR in dB that is tolerable
      for this system to function?

4. a) What is the difference between modulation rate and data rate?

   b) What is differential encoding? Why use it?

   c) What is Manchester coding? What are its advantages and disadvantages?

5. a) Describe 4 methods for encoding digital data using analog transmission. Give examples of each.

   b) What does this constellation represent?

   c) What data rate can this coding produce if the
      available bandwidth is 10 kHz?