CpE 319 **Name _____**

Winter Semester 2003 **Exam 1**

Show all work on the exam sheets; if more space is needed, please use back of pages. Open text and open notes; no other books. Numbers in bold indicate point value of question.

1. **(16 Points)** Which of the ISO OSI layers handles each of the following (use terminology as in Figure 1-20, p. 39)

   (a) Breaking the transmitted bit stream into frames _____

   (b) Determining which route through the subnet to use _____

   (c) Determining the type of file to be transmitted _____

   (d) Determining the length of time a bit lasts _____

2. **(6 Points)** List two ways in which the OSI reference model and the TCP/IP reference model are the same. Now list two ways in which they differ.

3. **(4 Points)** A system has an n-layer protocol hierarchy. Applications generate messages of length M bytes. At each of the layers, an h-byte header is added. What fraction of the network bandwidth is filled with headers?

4. **(6 Points)** Radio antennas often work best when the diameter of the antenna is equal to the wavelength. Reasonable size antennas range from 1 cm to 5 meters. What frequency range does this cover?

5. **(6 Points)** If a 64-level digital signal is sent over a 4-kHz channel whose signal-to-noise ratio is 30 dB, what is the maximum achievable data rate? Explain your answer.

6. **(18 Points)** Three packet-switching networks each contain 4M nodes. The first network has a star topology with a central switch. The second network is a bi-directional ring. The third is fully inter-connected. What are the best, average, and worst-case transmission paths in number of hops?

	Best	Average	Worst-Case
Star	_____	_____	_____
Ring	_____	_____	_____
Fully Inter-connected	_____	_____	_____

7. **(10 Points)** A three-element transmission series has an input power level of 4 mW, the first element is a transmission line with a 12 dB loss (-12 dB), the second element is an amplifier with a 35 dB gain, and the third element is a transmission line with a 10 dB loss (-10 dB).

   (a) What is the net gain or loss from input to output?

   (b) What is the output power?

8. **(6 Points)** In a typical cellular telephone system with hexagonal cells, it is forbidden to reuse a frequency band in an adjacent cell. If a total of 840 frequencies are available, how many can be used in a single cell?

9. **(5 Points)** In a constellation diagram, all points lie on a circle centered on the origin. What kind of modulation is being used?

10. **(8 Points)** Circle the correct answer from the choices for each question below.

    (a) A geostationary satellite's orbital height above the earth is approximately:

    2,500 miles 22,500 miles 222,500 miles

    (b) The propagation delay from an earth station to a GEO satellite and back to an earth station is approximately:

    .025 sec .25 sec 2.5 sec

11. **(4 Points)** Why has the Pulse Code Modulation sampling time been set at 125 μs?

12. **(5 Points)** Ten signals, each requiring 4000 Hz, are multiplexed on to a single channel using FDM. How much minimum bandwidth is required for the multiplexed channel? Assume that the guard bands are 400 Hz wide.

13. Answer the questions below given the binary chip sequences for two stations (A and B) using a Code Division Multiple Access system:
    A: 0 0 0 0 0 1 0 0 1
    B: 1 1 1 1 1 1 1 1 0

    a) **(2 Points)** Determine the bipolar chip sequences for A and B

    b) **(4 Points)** Determine the transmission sequence for $\overline{\mathbf{A}} + \mathbf{B}$