

INDIAN INSTITUTE OF TECHNOLOGY, KHARAGPUR

Date 20.02.2006 AN Time: 2 Hrs.

Full Marks 60

No. of Students: 70

Autumn Semester:, 2005

Department: Computer Science and Engineering

Sub. No: CS 33006

3<sup>rd</sup> and 4<sup>th</sup> Yr. B. Tech.(Hons.)

Sub. Name: Computer Networks

**Instructions :** Answer **all** the questions. Please write short and precise answers

1. (a) State the seven layers in ISO-OSI models.
- (b) Define bandwidth.
- (c) What is spectrum of a signal.
- (d) Define attenuation.
- (e) State three different *guided transmission media*.
- (f) What is line of sight propagation?
- (g) Explain *exchange management* as a communication task.
- (h) Define SNR.
- (i) What is simplex, half-duplex, full-duplex?
- (j) Define frequency-hopping spread spectrum.

[1 × 10]

2. (a) Decompose the signal  $(1 + 0.1 \cos 5t)\cos 100t$  into a linear combinations of sinusoidal function, and find the amplitude, frequency, and phase of each component.
- (b) Define Decibel-watt. An amplifier has an output of 20W. What is its output in dBW?
- (c) Define channel capacity. Mention the (four) key factors affecting channel capacity.
- (d) Define Nyquist and Shannon Capacity formula. Establish relationship between them considering channel spectrum is between 3 MHz to 4 MHz and  $\text{SNR}_{db} = 24\text{db}$ .
- (e) Draw and mention the basic elements of a single communication model. Write **one** line (for each) stating the function of each element.

[2 + 2 + 2 + 2 + 2]

3. (a) State the important advantages (at least 4) of digital transmission.
- (b) Room temperature is usually specified as  $T = 17^\circ\text{C}$ , or 290 K. What is then the thermal noise power density.
- (c) State and illustrate the principle of video interlacing scanning.  
Given that there are 483 lines in a TV screen, 30 scans/sec, and width to height ratio of the TV screen to be 4:3 what is the bandwidth of the video signal needed.

- (d) For binary phase shift keying ,  $E_b/N_o = 8.4\text{db}$  is required for a bit error rate of  $10^{-4}$  (one bit error out of every 10,000). If the effective noise temperature is  $290^\circ\text{K}$  (room temperature) and the data rate is 2400 bps, what received signal level is required ?

$$[2 + 2 + (2 + 2) + 2]$$

4. (a) Describe briefly the datagram technique of packet switching and its advantages and disadvantages over virtual circuits.
- (b) List clearly, with a **one** sentence description of each, three important goals of a routing protocol.
- (c) Show clearly a sequence of events, along with the routing tables at each node, to illustrate the counting-to-infinity problem in a basic distance vector routing protocol (the routing loop must involve at least 4 nodes).

In order to solve this problem, a router at node X adopts the following scheme over and above the basic distance vector protocol. Whenever X sends an update to a neighbor Y, if it has a route for some other destination Z initially received from Y (i.e., Y is the next hop on the route), it sends the route to Y with a cost of infinity, irrespective of the actual cost stored in the routing table of X. For example, if the route entry in X's table is (dest=Z, cost=4, next\_hop=Y), X still sends (dest=Z, cost=infinity) to Y. The route is sent correctly to all other neighbors (other than Y). Do you think this will completely solve the counting-to-infinity problem, reduce the chance of the problem happening, or not affect the problem at all? Justify clearly with an example.

- (d) Consider a link state routing protocol in which a node initially floods information about links incident on it to all the nodes in the network. After that, it floods information about the links only when there is a substantial change in that information (the exact definition of what is *substantial* is not important here). The information sent by a node is carried in datagrams that are flooded. At each node, a datagram is forwarded to all neighbors except the neighbor from which it is received, but only if it has not been forwarded before at this node (assume that there is some mechanism at each node to detect duplicate datagrams). Comment on the correctness of the protocol. Your answer should be brief and clear.

$$[4 + 3 + (5 + 4) + 4]$$

5. (a) Given the data 0 1 0 0 1 1 0 0 0 1 1, encode it in NRZ-L, NRZI, Bipolar-AMI, Pseudoternary, Manchester and Differential Manchester encoding formats.
- (b) Consider an audio signal with spectral components in the range 300 to 3000 Hz. Assume that a sampling rate of 7000 samples per second will be used to generate a PCM signal. Data sample is encoded in 8-bit. What data rate is required?
- (c) Define *biphase encoding* and describe two biphase encoding techniques.
- (d) State 2 principal reasons for analog modulation of analog signals.

$$[3 + 3 + 3 + 1]$$