CS 31204: Computer Networks
Spring 2023

Full Marks: 20 **Class Test 1, February 3, 2023** **Time: 50 minutes**

NAME: **ROLL NO.:**

1. If a 4 milliwatt signal is sent by a sender over a 10 km long media with attenuation 0.3 dB/km, what will be power of the signal received? No calculation needs to be shown. (1)

   10 km means 0.3x10 = 3dB attenuation. Simple calculation shows signal received will be approx. 2 milliwatt.

2. A sender starts sending a frame (with no preamble or postamble) of size 150 bytes at the rate of 10 Mbps over a 1 Km long media with propagation delay of 2 x 10^8 meters/sec. After how long will the frame be received at the receiver? No calculation needs to be shown (1)

   Time after which last bit of frame is transmitted = (150 x 8)/10 = 120 microsec.
   Time after which last bit of frame reaches the receiver = propagation delay = 1000/(2 x 10^8) sec = 5 microsec.
   Frame is received when the last bit is received, i.e. after (120 + 5) = 125 microseconds.

3. Two electrical wires are used from a machine A to send the signal and ground to a machine B 5 feet away. What will happen if the wires are not twisted into a twisted pair (one sentence only)? (1)

   At only 5 feet distance inside a room away from outside interference sources, there will be hardly any effect of any interference on the communication whether the wire is twisted or not (unless there are special circumstances, which then you need to tell something).

4. What is a step-index/graded-index optical fibre (one sentence only)? Can you transmit the data of multiple sender-receiver pairs simultaneously over an optical fibre (justify your answer in one sentence only)? (1 + 1)

   A step-index optical fiber is one in which the density (refractive index) of the core is uniform while in a graded-index one, the density is highest at the center of the core and gradually decreases towards the cladding.

   Yes, can be done using wavelength division multiplexing.

   (This question was confusing as step-index and graded-index are two different things, ok if you defined any one correctly).

5. What is scrambling? (One sentence only) (1)

   Scrambling is a technique in which long strings of 0's and 1's are replaced by predefined sequences of same size at the time of encoding to aid in synchronization.

6. Consider a system using Go-Back-N ARQ with 2-bit sequence numbers with window size 3. The system sends one frame per unit time, acks are sent separately for each frame received, and the round trip time is 3 time units. The system starts sending the frames from t=0, and the 4-th frame sent is lost. How many frames are sent before the loss is detected? What frame numbers will be resent? No explanation is needed. (1+2)

   Sender sends frames 0, 1, 2 at times t=0,1,2, then stops as window size is reached. The first ack (for frame 0) comes back at t=3, at which time frame 3 is sent. This is the 4th frame sent which is lost. Now ack for frame 1 and 2 sent earlier comes back at t=4 and 5 respectively, and frames 0 and 1 are sent at t=4 and 5 accordingly. Now there are again 3 unacknowledged frames, 3, 0, 1, and window size is reached, so nothing else is transmitted. The loss of the 4th frame (frame 3) is detected at t=6, and unack'ed frames 3, 0, 1 are all sent again. So total number of frames sent before loss is detected is 6. Ok if you have started counting after 3 is sent and answered 2 (or specifically told where you started counting from and gave correct answer with that reference). The frames resent are 3, 0, 1.

7. Show the encodings for the bit pattern 1000100010011 using Bipolar-AMI and Differential Manchester encoding, assuming that the last signal level has been positive. No explanation is needed at all. (2)

   Easy, Follow textbook.

8. In checksum computation, we break the data into fixed size blocks first. So should you choose large block size or small block size? Give one advantage of each (one sentence only for each). (2)

   Larger block size gives more error detection capability. Smaller block size gives less overhead.

9. Consider an audio signal (analog) with spectrum 2 KHz to 10 KHz being sampled using Nyquist sampling rate. Each sample is encoded into 16 bits of digital data and transmitted using Manchester encoding. What would be the minimum bandwidth of the channel needed in MHz? Show your calculations. (3)

   Max frequency = 10 KHz, so by Nyquist Sampling Theorem, minimum sampling rate is 20K samples/sec
   So data rate needed is 20K x 16 = 320Kbps
   Since Manchester encoding is used, maximum signalling rate is twice the data rate, so data rate to be supported is 640 Kbps.
   Manchester encoding means 2 signaling levels. So from Nyquist channel capacity formula,
   $640 \times 10^3 = 2B$ *(B is minimum bandwidth needed, M = 2 here for Manchester)*
   Thus, minimum bandwidth B needed is 320 KHz.

10. Machine A wants to send a 127 MB video file to a machine B in a system using CSMA/CD for medium access with minimum frame size of 128 bytes and maximum frame size of 1024 bytes. Header size in a frame is 8 bytes. The maximum distance between two machines in the system is 1 Km, and the propagation delay is 2×10^8 meter/sec. What will be the minimum time taken to transfer the file assuming that there is no collision and no errors. Show your calculations. (4)

    Since minimum frame size is 128 bytes, using formula for minimum frame size in CSMA/CD,
    $128 \times 8 = ((2 \times 10^3) \times R)/(2 \times 10^8)$ *where R is the data rate, so R = 102.4 Mbps*

    To send the video file, user should send data using maximum frame size to reduce total header overhead

    No. of frames needed $= (127 \times 10^6)/(1024-8) = 125{,}000$
    Transmission time per frame $= (1024 \times 8)/(102.4 \times 10^6) = 80$ *microseconds*

    So time to transmit all frames = 125000 x 80 = 10 seconds

    Ignored the propagation delay of 5 microseconds as frames are sent one after the other without break so the effect of the propagation time of last bit on the total transfer time is negligible. Ok if you considered it.