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)

   ANS: 2 milliwatt.

   Give 0 if anything less than 2 or anything greater than 2.1 mW. Give 0.5 if value correct but milliwatt/mW not mentioned.

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)

   ANS: 125 microseconds.

   Give 1 if 125 microsecond, 0 otherwise. Give 0.5 if value is correct but no unit mentioned.

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)

   ANS: 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).

   Give 1 if they mention anywhere that the chance of having interference in a room is low and/or small interferences will not matter at such short distances. Give 0.5 if they just say there will be interference. Give 0 if interference is not mentioned in any way at all.

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)

   ANS: 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.

   Give 1 if they define either step-index or graded index (any one) correctly. Grade leniently as long as they have the idea ok.

   ANS: Yes, can be done using wavelength division multiplexing.

   Give 1 if they have the term WDM or Wavelength Division Multiplexing there, 0 otherwise.

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

   ANS: 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.

   Give 1 as long as they say replacing strings of 0 and 1 with another sequence.

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)

ANS: 6 frames, frame numbers 3, 0, 1. Ok if they say 3 frames, frame numbers 3, 0, 1

For no. of frames, give 1 for 6 or 3, 0 otherwise. For frame no.s transmitted, give 2 if 3, 0, 1, otherwise 0.

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)

Hard to draw here ☺ Draw yourself and bring.
For both, give 1 if fully correct, 0 otherwise
For Bipolar-AMI, Ok if they have used high voltage for either 0 or 1.

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)

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

1 marks for each. Binary marking for each, 0 or 1.

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)

ANS:
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.

1 mark for correct number of samples
1 mark for data rate needed (give 0.5 if they miss that for Manchester, you need to double). Grade based on whatever no. of samples they got in first part (i.e., if first part is wrong, should not lose marks in 2nd part if that is ok)
1 mark for minimum bandwidth by Shannon Capacity formula (give 0 if they use anything else)

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)

ANS:
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

(1) Taking MB as 2^{20},
No. of frames needed = $(127 \times 2^{20})/(1024-8) = 131072$
Transmission time per frame = $(1024 \times 8)/(102.4 \times 10^6) = 80$ *microseconds*
So time to transmit all frames = 131072 x 80 = 10.485 seconds

(2) Taking MB as 10^6

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 = $125000 \times 80 = 10$ 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 they considered it. Values will change very slightly.

1 marks for data rate computation
1 mark for No. of frames (give 0.5 if they fail to see that they have to send maximum sized frames to minimize time or that they have to deduct header size from frame size))
1 mark for computing transmission time per frame

Even though for size, MB = 2^{20}, ok if they have used 10^6. Ignore very minor calculation errors as long as they have the idea fine.