ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION   **SUMMER SEMESTER, 2021-2022**
DURATION: 1 HOUR 30 MINUTES   **FULL MARKS: 75**

CSE 4279: Data and Telecommunications

Programmable calculators are not allowed. Do not write anything on the question paper.
Answer **all 3 (three)** questions. Figures in the right margin indicate full marks of questions.

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1. a) Umair and Abdullah are talking over landline (Traditional Phone). Landline uses permanent   6
      infrastructure made of wire. Identify different components Data Communication in the mentioned
      communication. How would this scenario change if they were talking over WhatsApp (a mobile app
      using traditional internet) video calls?

   b) How many levels of addresses are used in TCP/IP Protocol? What are the addresses and which OSI   9
      layer defining these addresses? Write down the significance or necessity of each level of address. In
      Figure 1, the Physical Address is represented with English letter and Logical Address is represented
      with numerical value. Example: Top-Left PC (sender) has physical address P and Logical Address
      11. Here, sender with logical address 11 sends data to receiver with logical address 88. Draw the
      Datagrams and Frames with the '?' sign mentioning different addresses.
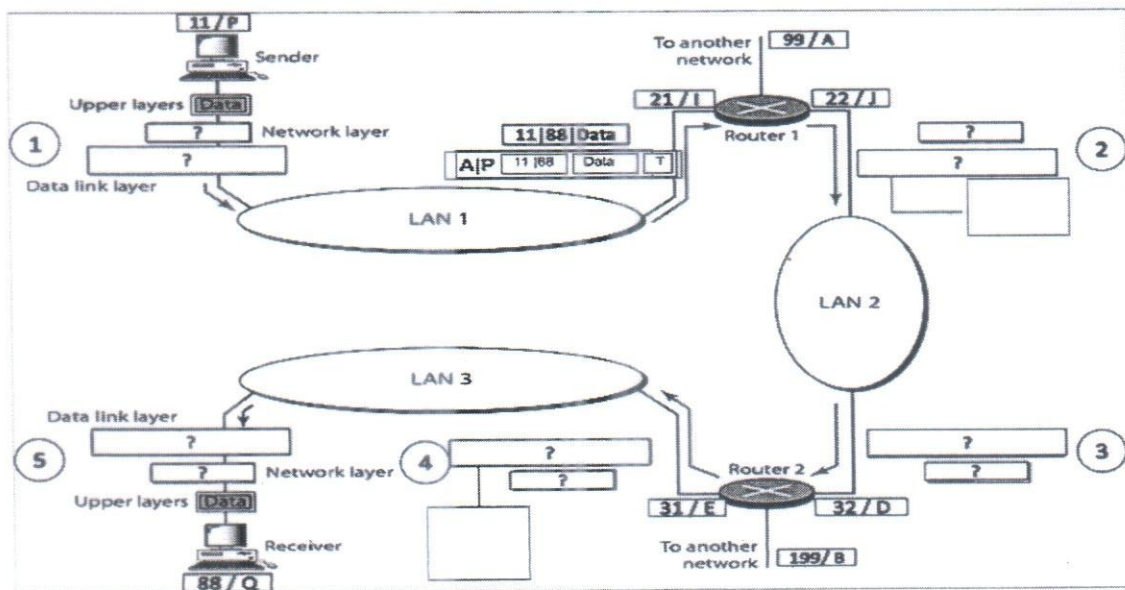

Figure 1: Figure for Question 1.b)

   c) How are OSI and ISO related to each other? How does OSI model differ from the TCP/IP protocol   10
      suite? Explain Process-to-Process delivery, Host-to-Host delivery, and Node-to-Node delivery in
      terms of the TCP/IP protocol suite.

2. a) What is Bandwidth-Delay product? Briefly explain different components of Latency (Delay). A   7
      frame of 1KB size is sent from source to destination. The transmission speed of the source is 1Mbps.
      A wired medium of CAT5 cable is used for this communication which has an average propagation
      speed of 2.4×10^8 m/s. There were no intermediate nodes and the distance between source and
      destination is 200 m. Calculate the total delay.

   b) Multiplexing and spreading are two ways of bandwidth utilization. How do they differ? What are   8
      the relative advantages and disadvantages of Statistical TDM over synchronous TDM? In a
      synchronous TDM multiplexing technique, input data rates are 15, 20, 30, 40, and 40 kbps that need

to be multiplexed and the output line has a capacity of 200 kbps. Draw the block diagram to show how disparity of data rates will be handled. Explain each of the techniques.

OR

Give the taxonomy of digital-to-analog conversion techniques. Which of the techniques are most susceptible to noise? Justify your answer. Briefly explain the bandwidth requirements of different analog-to-analog conversion techniques. **8**

c) 'In data communications, we commonly use periodic analog signal and non-periodic digital signal'- Justify the statement. Explain the concept of digital signal as a composite analog signal. Briefly explain different approaches to transmit a digital signal from one point to another point. **10**

3. a) In NRZ encoding scheme, positive voltage defines bit 1 and zero voltage defines bit 0, In **NRZ-L**, level of the voltage determines the value of the bit. On the other hand, in **NRZ-I**, the change or lack of change in the level of the voltage determines the value of the bit. If no change the bit is 0, If there is change, the bit is 1. The idea of RZ (transition at the middle of a bit) and the idea of NRZ-L are combined into the **Manchester** scheme. **Differential Manchester**, on the other hand combines the idea of RZ and NRZ-I. There is always a transition at the middle of the bit, but the bit values are determined at the beginning of the bit. **6**

Now explain the following pitfalls and explain in which scenarios of the input signals (Long string of 0 or long string of 1) these four schemes will face these pitfalls:

  i. DC Component   ii. Self-Synchronization   iii. Baseline Wandering

b) 8B6T is a very interesting multilevel scheme used with 100BASE-4T cable where, a pattern of 8 bits is encoded as a pattern of 6 signal elements with three signal levels. The redundant signal elements provide synchronization, error correction, and DC balance. Convert the following hexadecimal string to 8B6T signal and provide the rationale of the above statements. **6**

03 6A 69 20 49 2A

Draw the signal with notations. You can use multiple line if it does not fit in a single line. A partial table of 8B6T code is given in Table 1.

Table 1: Partial table of 8B6T code for Question 3.b)

Data	Code	Data	Code	Data	Code	Data	Code
00	-+00-+	20	-++-00	40	-00+0+	60	0++0-0
01	0-+-+0	21	+00+--	41	0-00++	61	+0+-00
02	0-+0-+	22	-+0-++	42	0-0+0+	62	+0+0-0
03	0-++0-	23	+-0-++	43	0-0++0	63	+0+00-
04	-+0+0-	24	+-0+00	44	-00++0	64	0++00-
05	+0--+0	25	-+0+00	45	00-0++	65	++0-00
06	+0-0-+	26	+00-00	46	00-+0+	66	++00-0
07	+0-+0-	27	-+++--	47	00-++0	67	++000-
08	-+00+-	28	0++-0-	48	00+000	68	0++-+-
09	0-++-0	29	+0+0--	49	++-000	69	+0++--
0A	0-+0+-	2A	+0+-0-	4A	+-+000	6A	+0+-+-
0B	0-+-0+	2B	+0+--0	4B	-++000	6B	+0+--+

c) MLT-3 is a differential coding scheme with more than two transition rules which maps one bit to one signal element (similar to NRZ-I). Explain the MLT-3 scheme with a suitable example and necessary state transition diagram. Justify the rationale of greater complexity (three level and complex transition rules). **8**

d) State the Nyquist theorem for sampling rate used in PCM. Briefly explain quantization error of PCM. **5**

OR

Assume that a voice channel occupies a bandwidth of 4-kHz. We need to combine three voice channels into a link with frequency spectrum from 50 to 65 kHz. Show the configuration using Block Diagram (both multiplexing and demultiplexing) using frequency domain. **5**