Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	DATA COMMUNICATION NETWORK
COURSE CODE	:	BEJ 31202
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	JULY/ AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER ALL QUESTIONS 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK.** 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **NINE (9)** PAGES

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Q1 (a) Based on your understanding, justify the reason the Transmission Control Protocol (TCP) header is longer than the User Datagram Protocol (UDP) header.

(3 marks)

(b) In data communication, give example of de facto and de jure standard.

(2 marks)

(c) Draw the layerings of TCP/IP and show Protocol Data Unit (PDU) for each layer.

(4 marks)

(d) Synchronization is one of the fundamental requirements in the transmission of a bit stream between two devices. There are two solutions to synchronize the clocks at transmitter and receiver.

(i) Differentiate the synchronous and asynchronous transmission strategy scheme.

(3 marks)

(ii) Deduce the effect of small timing differences on short stream and long stream bits for asynchronous transmission

(3 marks)

(e) Consider an Unshielded Twisted Pair (UTP) cable with a bit rate of 10 Mbps and a propagation delay of 4 μs/km. A sender wants to transfer a 5 kB file to a receiver connected through a 10,000 km UTP cable. Compare the propagation time and the transmission time to transmit this file.

(5 marks)

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Q2 (a) Categorize the following encoding schemes either two level binary codes, multilevel binary codes, or bi-phase technique.

(i) Differential Manchester Encoding
(ii) 2 bits/signal element NRZ-I

(2 marks)

(b) Draw the encoding signal, as shown in **Figure Q2(b)**, for a stream of binary bits 10100100000000100001 using Differential Manchester, bipolar with 8-zeros substitution (B8ZS) and high-density bipolar-3 zeros (HDB3) (starting with a high-level signal).

(6 marks)

(c) The role of error detection mechanism is to detect errors that occurs between the transmission and reception of data, especially when one or more bits are altered. Suppose that a system intends to send a data stream of $D = 10111010100010$.

(i) If an Odd Parity Check scheme is used and the received codeword is 101010101010100, then determine the error.

(2 marks)

(ii) If Cyclic Redundancy Check (CRC) scheme is used with polynomial generator $x^3 + x^2 + 1$. Compute the CRC code and the transmitted data frame.

(4 marks)

(d) Suppose that a sender sent several frames to a receiver. The first frame had been delivered successfully and the sender had received the acknowledgment frame as shown by the timing diagram in **Figure Q2(d)**. However, the third frame had lost during transmission, so the receiver sent the acknowledgement frame to notify the frame lost. After the transmitter received the acknowledgement, the appropriate frames had been retransmitted and received by the receiver. The receiver is then sent the acknowledgment, but this acknowledgment frame was lost.

(i) State the error flow method that is used in **Figure Q2(d)**.

(1 mark)

(ii) Complete the timing diagram with the appropriate acknowledgement and frame numbers to show the exchanged frames between the sender and receiver to deliver all the frames.

(5 marks)

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Q3 (a) Switched communication network is used to accomplish the data transmission from the source to destination for a long-distance transmission. The switching nodes does not concern with the content of data but instead it provides a switching facility to move the data through nodes until the data reaches the desired destination.

(i) Prove that the space division switching in **Figure Q3(a)(i)** have $n(n-1)$ unutilized switches where n refer to the number of stations.

(2 marks)

(ii) By modifying **Figure Q3(a)(ii)**, explain how three stage space division switches can reduce the number of blocking.

(3 marks)

(b) Consider a network topology as illustrated in **Figure Q3(b)**. The topology consists of multiple routers interconnected by links. Each link has a static cost associated with it which represents the cost of sending data over that link. Apply Dijkstra routing algorithm to the network in **Figure Q3(b)** for node 1 to all other nodes. Show your work by completing the Least-Cost Routing algorithm table consisting of each iteration.

(8 marks)

(c) A 3200-bit message must be transmitted through a three-hop Wide Area Network (WAN). Each network link has a maximum capacity of 9600 bps. A fixed packet size of 128 bytes is used to send data over the network. Assuming a propagation delay of 0.002 s per hop and a call setup time of 0.1 s,

(i) calculate end-to-end delay incurred to transmit the whole message on circuit switched network.

(2 marks)

(ii) calculate end-to-end delay incur to transmit the whole message on virtual circuit packet switching network.

(5 marks)

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Q4 (a) Consider a network with 12 stations (hosts) connected to a 10 Mbps Ethernet. Assume that the throughput of the Ethernet is the total rate at which data is delivered to all the hosts, and all frames are addressed to individual stations, not to group or broadcast addresses. Calculate the maximum possible throughput for the following network topology configuration:

(i) Each host is connected to a single hub (repeater).

(2 Marks)

(ii) Each host is connected via a half-duplex interface to a single Ethernet switch (bridge).

(2 Marks)

(iii) Each host is connected via a full-duplex interface to a single Ethernet switch (bridge).

(2 marks)

(b) By using appropriate diagrams, explain the operation of hub and layer 2 switch.

(4 marks)

(c) By using your own word, differentiate the operation of ALOHA, Carrier Sense Multiple Access (CSMA) and Carrier Sense Multiple Access/Collision Detection (CSMA/CD).

(4 marks)

(d) Assume that there are only **TWO (2)** stations A and B, in a CSMA/CD network. The distance between these two stations is 2000 m and the propagation speed is 2×10^8 m/s. If station A starts transmission at time t_1:

(i) then station B starts transmitting at time $t_1 + 8\,\mu s$, determine whether the CSMA/CD protocol allows station B to access the channel. Explain your answer.

(3 marks)

(ii) then station B starts transmitting at time $t_1 + 11\,\mu s$, determine whether the CSMA/CD protocol allows station B to access the channel. Explain your answer.

(3 marks)

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Q5 (a) A block of addresses is granted to a small company. One of the addresses is given by 205.20.40.40/26.

(i) Determine total number of hosts that can be assigned in the company using the granted block addresses.

(2 marks)

(ii) Determine the first address in the block.

(3 marks)

(ii) Determine the last address in the block.

(4 marks)

(b) An organization is given a block of IP addresses which is 17.16.40.0/24. You are as a network engineer needs to divide the addresses into subnets for **FOUR (4)** departments in the organization as follows:

Engineers and Technical Department: 56 hosts

Customer and Service Department: 35 hosts

Support Unit Department: 20 hosts

Human Resource Department: 18 hosts

(i) Produce the possible arrangement of subnet numbers, subnet mask, and range of IP addresses for each department to make this possible.

(10 marks)

(ii) Calculate number of addresses that are still available after these allocations

(1 mark)

-END OF QUESTIONS –

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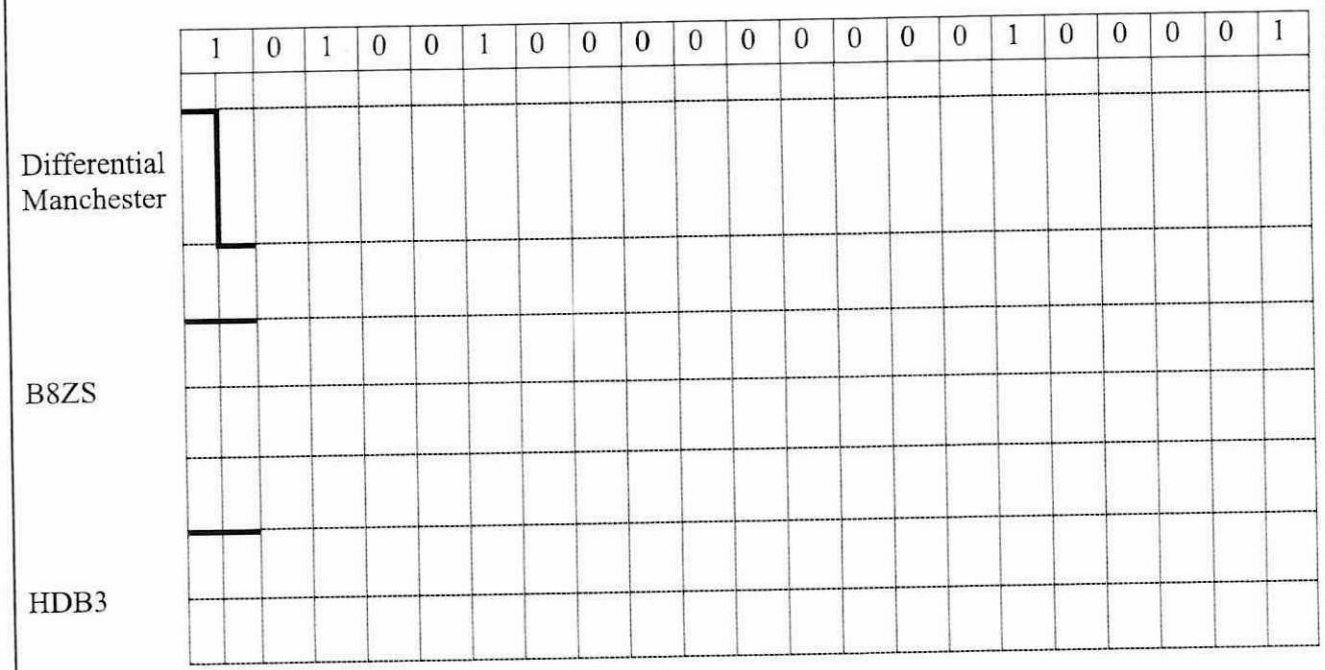

Figure Q2(b)

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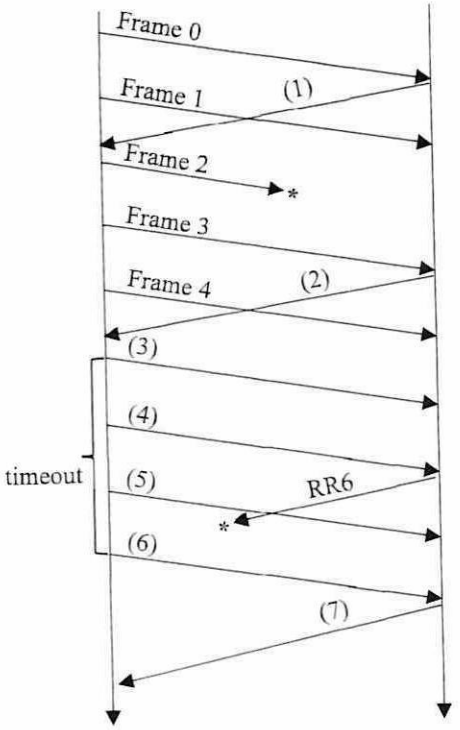

Figure Q2(d)

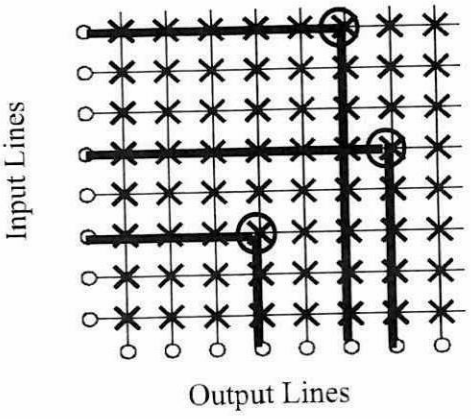

Figure Q3(a)(i)

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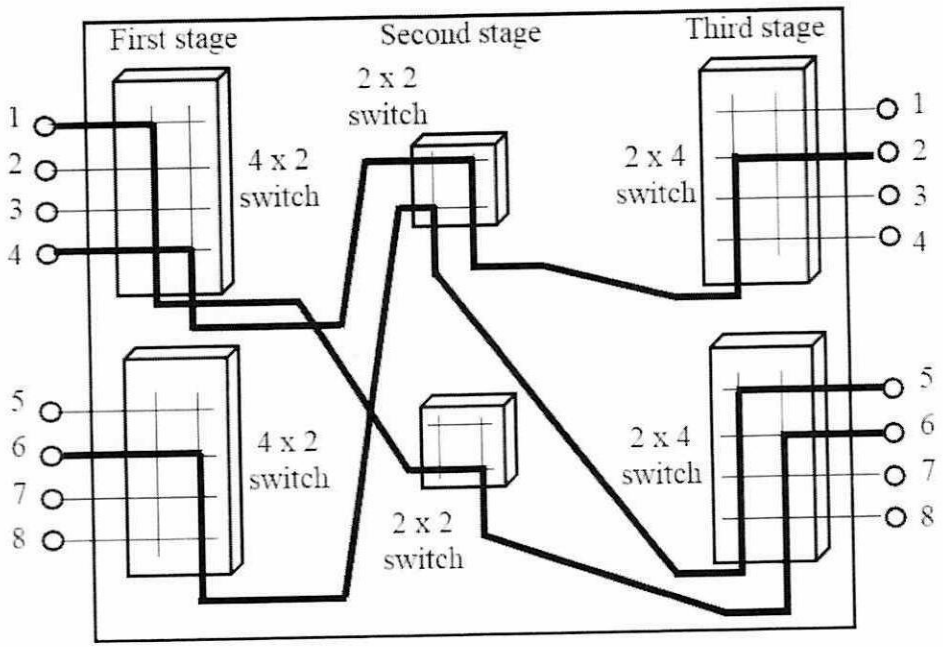

Figure Q3(a)(ii)

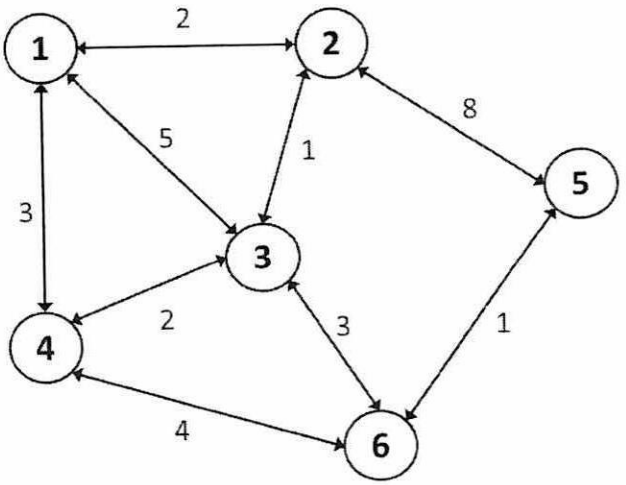

Figure Q3(b)

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