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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER I
SESSION 2022/2023**

COURSE NAME : DATA COMMUNICATION NETWORKS

COURSE CODE : BEJ 31202

PROGRAMME CODE : BEJ

EXAMINATION DATE : FEBRUARY 2023

DURATION : 3 HOURS

INSTRUCTION : 1. ANSWERS ALL QUESTIONS.

2. THIS FINAL EXAMINATION IS A 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 **SIX (6)** PAGES

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TERBUKA

Q1 (a) For each of the following items, determine which layer of the Open System Interconnection (OSI) protocol stack it belongs to:

- (i) Cyclic Redundancy Check (CRC)
- (ii) Pseudoternary encoding
- (iii) User Datagram Protocol (UDP)
- (iv) Bit stuffing
- (v) Routing
- (vi) Twisted pair cable
- (vii) Hub
- (viii) Go Back N
- (ix) Telnet

(9 marks)

(b) A digital signalling system is required to operate at 10 Mbps. Suppose that it is used to operate over **TWO (2)** channels as follows:

Channel A: noiseless system and each symbol is capable to encode 4-bit/signal element, and

Channel B: non-noiseless system with signal to noise ratio of 6 dB.

(i) Determine the minimum required bandwidth for the Channel A.

(2 marks)

(ii) Calculate the minimum required bandwidth for the Channel B.

(2 marks)

(iii) Predict what will happen to the channel capacity of Channel A, if a higher number of encoding levels is used, as well as the channel capacity of Channel B if larger noise power interrupted the channel.

(2 marks)

(c) Consider an Unshielded Twisted Pair (UTP) cable with a bit rate of 10 Mbps and a propagation delay of 4 μ s/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)

- Q2** (a) One of the Transmission Control Protocol (TCP) features as a transport-layer protocol is its implementation of end-to-end flow control and error control to provide a reliable transmission. The mechanisms to detect and correct errors that occur during the transmission are referred to as error control or Automatic Repeat Request (ARQ).
- (i) Differentiate the operation of Go Back N ARQ and Selective Reject ARQ for **THREE (3)** cases: (1) the frame received by the receiver is damaged, (2) the acknowledgement is lost and has not been received by the transmitter, (3) the frame transmitted by transmitter is lost. (6 marks)
- (ii) Suppose that a well-known World Wide Web (WWW) server is set can receive relatively small messages from its clients while can send them very large messages. Analyse **TWO (2)** ARQ protocols: Selective Reject ARQ and Go Back N ARQ which would provide less burden to this server. (4 marks)
- (b) Twisted pair cable, coaxial cable and optical fibre cable are classified as a guided transmission medium.
- (i) Draw and label the physical construction of these **THREE (3)** transmission media. (3 marks)
- (ii) Give **ONE (1)** advantage and **ONE (1)** disadvantage of each transmission medium. (6 marks)
- (iii) State **ONE (1)** factor that affect the selection of this media. (1 mark)

- Q3** (a) Compare the timing diagram of Circuit switching and Packet switching for the network shown in **Figure Q3(a)**. Show and label all introduced delays in each type of switching technique including the propagation delay and transmission delay. Assume three packets flow from Host 1 to Host 2. (5 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 Campus Area Network (CAN). 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 incur 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)

- 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)

-END OF QUESTIONS -

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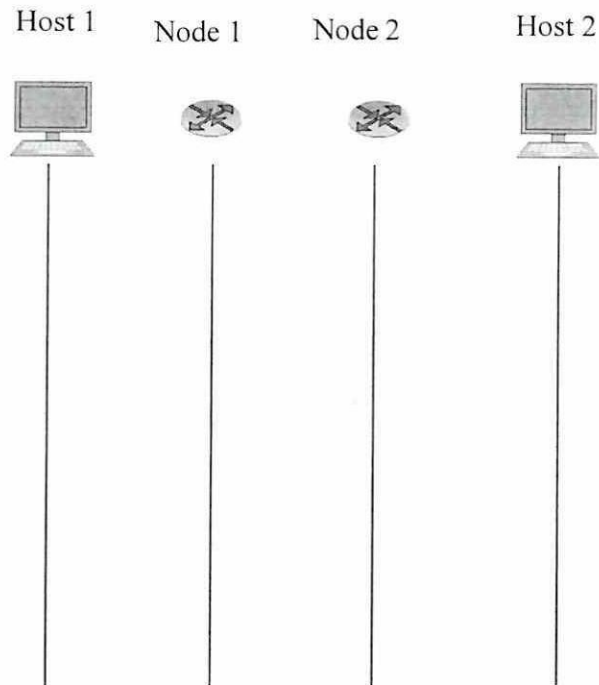


Figure Q3(a)

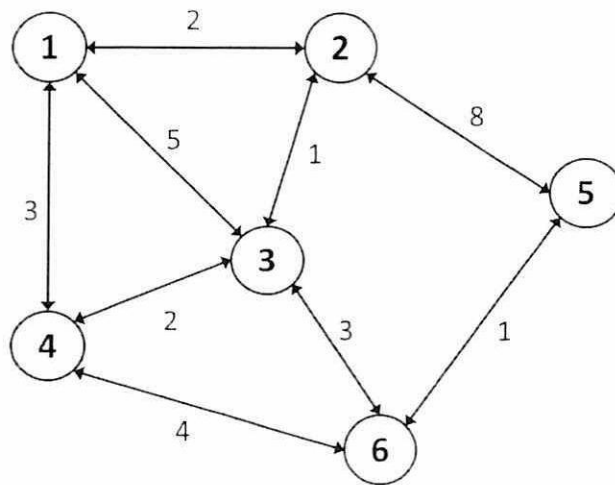


Figure Q3(b)