No of Pages : 4 Course Code : 12XW42

Roll No:
(To be filled in by the candidate)

PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

SEMESTER EXAMINATIONS, APRIL - 2014

MSc - SOFTWARE ENGINEERING Semester: 4

12XW42 DATA COMMUNICATION NETWORKS

Time: 3 Hours **Maximum Marks: 100**

INSTRUCTIONS:

1. Group I, Group II and Group III questions should be answered in the Main Answer Book.
2. Ignore the box titled as **"Answers for Group III"** in the Main Answer Book.
3. Answer **ALL** questions from GROUP – I.
4. Answer any **FIVE** questions from GROUP – II.
5. Answer any **ONE** question from GROUP – III.

GROUP - I **Marks : 10 x 3 = 30**

1. Why is digital transmission better than analog transmission over a long distance where repeaters are needed always?
2. Consider sending a message from a source host to destination host over the Internet using a fixed route. The source and destination host are separated from each other by four hops. Assume the message from the source host is sent using one packet at each layer. How many transport layer headers, network layer headers and data link layer headers are used in the transfer of this message to the destination?
3. How many new links are needed to add three new devices to an existing fully connected mesh, star, bus and ring topology network with eight existing devices?
4. What are the main differences between statistical time division multiplexing and synchronous time division multiplexing?
5. Two communicating devices are using a single-bit even parity check for error detection. The transmitter sends the byte 10101010 and, because of channel noise, the receiver gets the byte 10011010.Will the receiver detect the error? Why or why not?
6. Compare the 10BASE-T, 100BASE-T, 100BASE-F and Gigabit Ethernet. How do they differ?
7. A company has two locations: a headquarters and a factory about 25 km away. The factory has four 300-bps terminals that communicate with the central computer facilities over leased voice-grade lines. The company is considering installing TDM equipment so that only one line will be needed. What cost factors should be considered in the decision?
8. In Stop-and-Wait ARQ, why should the receiver always send an acknowledgment message each time it receives a frame with the wrong sequence number? Justify your answer through an example.
9. A network with one primary and four secondary stations uses polling. The size of a data frame is 1000 bytes. The size of the poll, ACK, and NAK frames are 32 bytes each. Each station has 5 frames to send. How much total bytes are exchanged if there is no limitation on the number of frames a station can send in response to a poll?
10. What are the requirements of CSMA/CD and CSMA/CA in local area networks?

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GROUP - II Marks : 5 x 10 = 50

11. Most digital transmission systems are "self-clocking" in that they derive the bit synchronization from the signal itself. To do this, the systems use the transitions between positive and negative voltage levels. These transitions help define the boundaries of the bit intervals.
    i) Plot the NRZ-L signal for the sequence of n consecutive 1s followed by n consecutive 0s. Explain why this code has a synchronization problem.
    ii) Repeat part (i) for NRZ-I encoding scheme. Does this scheme have a synchronization problem?
    iii) Repeat part (i) for the Manchester and differential Manchester encoding scheme and explain how the synchronization problem has been addressed.
    iv) Construct the digital signal for the binary string 0110110000000000010 using the high density bipolar of order 3 (HDB3) code. Analyze the performance of the HDB3 by considering the synchronization and DC component problem.

12. a) Explain the setup, data transfer and teardown process in data transmission. Answer the following questions by considering the given table:

Network	*Setup*	*Data Transfer*	*Teardown*
Circuit-switched	End-to-end		End-to-end
Datagram		End-to-end	
Virtual-circuit	End-to-end	Local	End-to-end

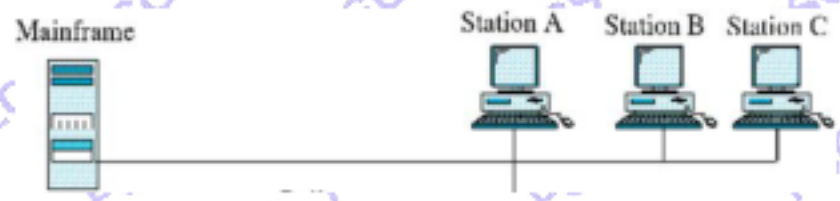
    i) Why does a circuit-switched network need end-to-end addressing during the setup and teardown phases? Why are no addresses needed during the data transfer phase of network for this type?
    ii) Why does a datagram network need only end-to-end addressing during the data transfer phase, but no addressing during the setup and teardown phases?
    iii) Why does a virtual-circuit network need addresses during all three phases? [5]

    b) Explain the need for data transparency in BSC and HDLC protocols. In order to indicate the start and end of a frame, the sender encapsulates the data flag, 01111110 (01^60) with the data in HDLC. Show how you would transmit this data "0011111011111011111000" by adding the start and end of flag frame, as well as ensuring that the flags were understood at the receiver. Suppose the received string is 01111110111110110011111001111101111011000111111010111110. Remove the stuffed bits and show where the ends of data flags are in frame. [5]

13. Explain why we use time division multiplexing for digital data in wired and unwired communication. Consider the Time Division Multiplexer that combines four sources sending the following characters. Note that the characters are sent in the same order that they are typed. The third source is silent.
    - Source 1 message: **HELLO**
    - Source 2 message: **HI**
    - Source 3 message:
    - Source 4 message: **BYE**

    i) Draw a diagram showing the data sent in each of the frames if the MUX is a synchronous TDM.
    ii) Draw a diagram showing the data sent in each of the frames if the MUX is a statistical TDM with a frame size of three data units.
    Identify the best TDM method to transmit data which improves the system throughput.

14. Explain the purpose of various frame types in HDLC protocol structure. Consider the following network. Primary node sends the poll request to A, B, and C. Nodes A and B are not having any data to transmit, so they are rejecting the poll request.



Node C begins the exchange of information with an frame numbered 0 followed by another frame numbered 1. Primary node piggybacks its acknowledgment of both frames from C along with its own data frame. Show how the Primary's first data frame is numbered and acknowledges receipt of C's frames 1 and 0 and indicating that it expects frame 2 to arrive next. Primary node transmits its second and third data frames before accepting further frames from node C. What will be the Primary's N(R) information for second and third frames? Node C has sent all its data. Therefore, it cannot piggyback an acknowledgment onto data frame and sends a flow control frame instead. The RR code indicates that C is still ready to receive. The number 3 in the N(R) field tells Primary node that frames 0, 1, and 2 have all been accepted and that C is now expecting frame number 3 from Primary node.

Construct the flow and error control diagram for the following scenario by indicating the frame type, frame sequence number and ACK or NAK number in the control field.

15. The following bits sequence is received by the destination device as the input to a channel decoder:

11001000101001

Determine if the received block of bits contains any bit errors (and, if possible, find the locations of any such error) if the channel coding scheme is based on:

i) Even Parity
ii) Checksum
iii) CRC-4 coding with a generator polynomial of $G(x)= x^4+x^3+1$
iv) Odd parity based Hamming Coding

Comment on the limitations of each scheme in terms of the maximum number of bit errors that can be reliably processed, number of redundancy bits to be added and undetected errors.

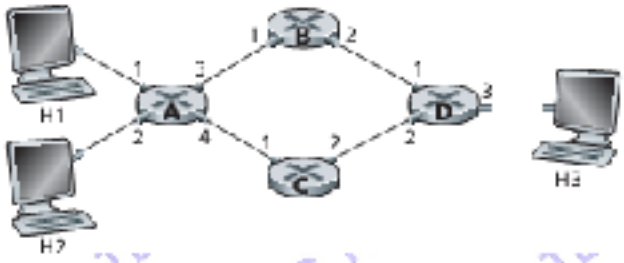
16. Explain the each field in frame structure of Ethernet protocol for the LAN networks with its purpose. Why does the Ethernet protocol maintain minimum size of the frame size as 64 bytes long?

GROUP - III

Marks : 1 x 20 = 20

17. In modern packet-switched networks, including the Internet, the source host segments, long application-layer messages (for example, an image or a music file) into smaller packets and sends the packets into the network. The receiver then reassembles the packets back into the original message. We refer to this process as message segmentation. What are reasons for breaking a long data transmission up into a number of segments, packets and frames?

i) Consider the message ($8 * 10^6$ bits long) is to be sent from source H1 to destination H3 without message segmentation with link speed is 2 Mbps. How long does it take to move the message from the source host to the first packet switch A? Keeping in mind that each switch uses store-and-forward switching, what is the total time to move the message from source host to destination host with intermediate switches?



ii) Assume that this network is a datagram network. Show the forwarding table in A, such that all traffic destined to host H3 is forwarded through interface 3.

iii) Assume that this network is a datagram network. Can you write down a forwarding table in A, such that all traffic from H1 destined to host H3 is forwarded through interface 3 of A, while all traffic from H2 destined to host H3 is forwarded through interface 4 of A?

iv) Assume that this network is a virtual circuit network and that there is one ongoing call between H1 and H3, and another ongoing call between H2 and H3. Write down a forwarding table in A, such that all traffic from H1 destined to host H3 is forwarded through interface 3, while all traffic from H2 destined to host H3 is forwarded through interface 4.

v) Assuming the same scenario as (iv), write down the forwarding tables in nodes B, C, and D.

18. Explain the need for using the sliding window protocol. Discuss the factors that should be considered in deciding window size in Go-back-N and Selective Reject ARQ to have reliable data transmission.

Give an example of when a Selective-Repeat ARQ might have a significant advantage over other ARQ schemes. You should show using diagrams or text how this would happen.

i) Assume a Sliding Window with Go-Back N ARQ is being used on a transmission link with a window size of 7 (window includes frames numbers 0 through 6). The transmitter has previously sent frames 0, 1 and 2. Is the transmitter allowed to send frame 3 if frame 2 has not been acknowledged? Explain your answer.

ii) Compare Go-back-to-N ARQ and Selective Repeat ARQ when the second frame is lost during the transmission from Sender to Receiver with a sliding window of size 8. What happens if the ACK that confirms the correct arrival of frames 0, 1 and 2 is lost on its way from the Receiver to the Sender in the two cases?

iii) Assume a Sliding Window with Go-Back N ARQ is being used on a transmission link with a window size of 7 (window includes frames numbers 0 through 6). If the transmitter sends frames 0, 1, 2 and 3, what is the size of the send window? If the receiver sends back ACK 3, what is the new size of the send window? What frame numbers are in the send window?

iv) Assume a Sliding Window with Selective-Reject ARQ is being used on a transmission link with a window size of 8 (transmit and receive window includes frames numbers 0 through 7). Host A sends frames 0, 1, 2, 3, and 4 to the receiver and frame 3 is received in error by Host B. What is the size of the receive window at Host B? What would be the frame number in the ACK sent back by Host B? What are the consequences taken care by the sender and receiver for this scenario?

/END/

FD/RL