Bachelor of Information Technology 2nd Year 2nd Semester Examination 2023

Sub: Computer Networks

Full Marks: 100 Time: 3 hours

Answer either (a) or (b) from each question

Answers must be brief and to the points

1.

a. (6+6+2+4+2)

i. Assume you want to transfer an n byte file along a path composed of the source, destination, 7 point-to-point links, and 5 switches. Suppose each link has a propagation delay of 2ms and a bandwidth of 4 Mbps, and that the switches support both circuit and packet switching. Thus, you can either break the file up into 1-KB packets or set up a circuit through the switches and send the file as one contiguous bit stream. Suppose that packets have 24 bytes of header and 1000 byte of payload, store-and-forward packet processing at each switch incurs a 1-ms delay after the packet has been completely received, packets may be sent out continuously without waiting for acknowledgements, and circuit set up requires a 1-KB message to make a round trip on the path, incurring a 1-ms delay at each switch after the message has been completely received. Assume introduces no delay to data traversing a circuit. You may also assume that file size is a multiple of 1000 byte.

1. For what file size n byte is the total number of byte sent across the network is less for circuits than for packets?
2. For what file size n byte is the total latency incurred before the entire file arrives at the destination less for circuits than for packets?
3. How sensitive these results are to the number of switches along the path?

ii. Identify the components in the delay that transpire from when a user makes a request for a telephone connection to when the connection is set up. Which of these components increase as the volume of connection requests increase?

iii. A system has an n-layer protocol hierarchy. Application generates message of length M bytes. At each of the layers, an h byte header is added. What fraction of bandwidth is filled with headers?

b. (10+6+4)

i. Assume a company ABC having a manager, a secretary, a route operator, a warehouse keeper cum security officer, and a transponder with a few trucks located at Jadavpur. The company is selling computers. Suppose the manager comes to know about an order from a company XYZ located at Andaman. The manager decides to supply computer for that order. Describe the operations to deliver computers from ABC to XYZ as a series of layers.

ii. Discuss the similarities and differences between the following national transportation network and a communication network.

1. Railroad Network
2. Highway System

iii. In most networks, the data link layer handles transmission error by requesting damaged frames to be retransmitted. If the probability of a frame's being damaged is p, what is the mean number of transmissions required to send a frame if acknowledgements are never lost?

2.

a. (10+3+7)

i. Suppose station A communicates to station C via station B. The distance between A and B is 4000 km and between B and C is 1000 km. The propagation delay is 5μs/km. The data rate between A and B is 100 kbps. A and B uses sliding window protocol with window size=4 frames. B and C use stop-and-wait ARQ protocol. All data frames are 1000 bits long and ACK frames are negligible. What is the required transmission rate between B and C, so that buffers of station B are not flooded?

ii. Consider a bit stuffing protocol that uses 011 as the delimiter. Show the bit sequence transmitted when the frame contains the following bit sequence.

110101111101011111101011111110

iii. Suppose we want transmit the message 10110010010011 and protect it from errors using the CRC-8 polynomial x^8+x^2+x+1. Determine the message that should be transmitted. Suppose the leftmost bit of the message is inverted due to noise. What is the result of the receivers CRC calculation?

b. (7+6+7)

i. Three possible strategies for sending ACK frames in a Go-back-N setting are as follows: send an ACK immediately after each frame is received, send an ACK after every other frame is received, and send an ACK when the next piggybacking opportunity arises. Explain which of these strategies are appropriate for the following situations.

1. An interactive application produces a packet to send each keystroke from the client; the server echoes each keystroke that it receives from the client.
2. A bulk data transfer application where a server sends a large file that is segmented in a number of full-size packets that are to be transferred to the client.

ii. Consider a 100 kbps satellite link with 550 msec roundtrip propagation delay. A sliding window protocol with 5-bit sequence number is used on the link. The frame size is 1000 bits. Find out the percentage of time the sender is blocked.

iii. Consider the go-back-n algorithm with a window size of 7. Draw the sender and receiver windows and also describe the actions of both sending and receiving protocols, specifying the buffer contents in the following case:

Station A sends frames 0-6. Station B receives them in order, but frame 4 was damaged.

3.

a. (10+4+2+4)

i. Suppose A, B, and C all make their first carrier sense, as part of an attempt to transmit, while a fourth station D is transmitting. Draw a timeline showing one possible sequence transmissions, attempts, collisions, and exponential backoff choices. Your timeline should also meet the following: i) initial transmission attempts should be in the order A, B, C but successful transmissions should be in the order C, B, A, and ii) there should be at least four collisions.

ii. In an 802.5 token ring, the sender removes its frame from the ring after the transmission is complete. What modifications would be necessary in the standard to have the receiver remove the frame instead? What would the consequence of this change be?

iii. List the issues that you must consider while connecting two different LANs.

iv. Give the Manchester and Differential Manchester encoding for the following bit pattern.

1 0 0 0 0 1 0 1 1 1 1

b. (3+5+4+8)

i. Modern Ethernet do not use CSMA/CD. Why?

ii. Consider a 200 meter 4 Mbps token ring containing 20 stations, each transmitting with equal priority. Suppose no station is allowed to transmit more than 5000 bytes before giving up the token. Once a station releases a token how long does it take for that station to get the token again? Assume a propagation speed of $2x10^5$m/s and token transmission time is negligible.

iii. Suppose that 80 percent of the traffic generated in a LAN is for stations in the LAN and 20 percent is for the stations outside the LAN. Is an Ethernet hub is preferable to an Ethernet switch or bridge? Does the answer changes if the percentages are reversed?

iv. Consider four stations that are attached to two different bus cables. The stations exchange fixed size frame of length 1 sec. Time is divided into slots of 1 sec. When a station has a frame to transmit, the station chooses either bus with equal probability and transmits at the beginning of the next slot with probability p. Find the value of p that maximizes the rate at which frames are successfully transmitted.

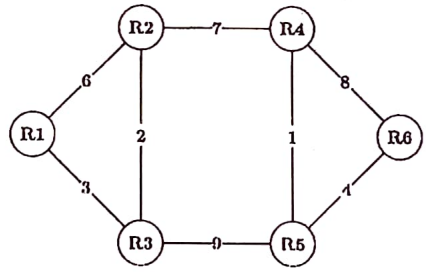
4.

a. (2+6+7)

i. Is there any difference between routing and forwarding?

ii. A token bucket scheme is used for traffic shaping. A new token is put into the bucket at every 10 micro second. Assume each token pick one packet which contain 2B of data. It is observed that initial capacity of bucket is 10 Mb. How long the computer can transmit at full speed of 8 Mbps?

iii. Consider the following network. All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbor with the weight of the respective connecting link. After all the routing tables stabilize, which links in the network will never be used for carrying any data?



b. (8+3+4)

i. Compare source routing with hop-by-hop routing with respect to packet header overhead, routing table size, flexibility in route selection, and QoS support for both datagram and virtual circuit networks.

ii. A token bucket scheme is used for traffic shaping. A new token is put into the bucket every 5 μsec. Each token is good for one short packet, which contains 48 bytes of data. What is the maximum sustainable data rate?

iii. What is the difference between flow control and congestion control? What are the reasons for which congestion may occur in a network?

5.

a. (7+4+4)

i. Suppose a TCP message that contains 1024 bytes of data and 20 bytes of TCP header IS passed to IP for delivery across two networks interconnected by routers (i.e., it travels from the source host to a router to the destination host). The first network has an MTU of 1024 bytes; the second has an MTU of 576 bytes. Each network's MTU gives the size of the largest IP datagram that can be carried in a link-layer frame. Give the sizes and offsets of the sequence of fragments delivered to the network layer at the destination host. Assume all IP headers are 20 bytes.

ii. Let us consider the following subnet mask. Find out its class and the number of subnets.

11111111 11111111 11000000 000000

iii. Three subnets have the following network prefixes:

57.6.96.0/21, 57.6.104.0/21, 57.6.112.0/21, and 57.6.120.0/21

If these network prefixes are aggregated into a single route, what will be the aggregated network prefix and the mask?

b. (4+5+6)

i. An organization wants to use the private network number 192.168.90.0 across four subnets. The maximum number of hosts that exist per subnet will be 25. What subnet mask would you use to solve this problem?

ii. The set of IP addresses from 29.18.0.0 to 29.18.128.255 has been aggregated to 29.18.0.0/17. However, there is a gap of 1024 unassigned addresses from 29.18.60.0 to 29.18.63.255 that are now suddenly assigned to a host using a different outgoing line. Is it now necessary to split up the aggregate address into its constituent blocks, add the new block to the table, and then see if any reaggregation is possible? If not, what can be done instead?

iii. Suppose a router has built up the following routing table:

Subnet Number	Subnet Mask	Next Hop
128.96.39.0	255.255.255.128	Eth0
128.96.39.128	255.255.255.128	Eth1
128.96.40.0	255.255.255.128	R2
192.4.153.0	255.255.255.192	R3
<default>		R4

Describe what the router does with a packet addressed to the address 128.96.40.12, 128.96.39.10, and 192.4.153.17.

6. (10)

a. Describe with suitable diagram the connection establishment mechanism of TCP.

b. Describe the congestion control mechanism of TCP.