Ref No: **Ex/IT/T/225/2018**

Bachelor of Information Technology 2nd Year 2nd Semester Examination 2018

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. (7+3+(2+2)+6)

i. You are given a communication link that transmits R bits per second. The objective is to transmit a file of length L bits. The bits are sent in packets; P bits of the file are sent in each packet, except for the last which contains all the leftover bits. A header of length H bits is added to each packet before it is transmitted over the link. Consecutive packets must be separated by at least G seconds. Derive an expression for the total time to transmit the file.

ii. What are the advantages and disadvantages of concentrator over TDM?

iii. Suppose all laptops in a large city are to communicate using radio transmissions from a high antenna tower. Is the data link layer or network layer more appropriate for this situation? Now suppose the city is covered by a large number of small antennas covering smaller areas. Which layer is more appropriate?

iv. Come up with a design of network architecture with four layers. Explain each layer of your design and assign an appropriate name to it.

b. (8+3+3+6)

i. We would like to transfer 20 KB file across a network from node A to node F. Packets have a length of 1KB (neglecting header). The path from node A to node F passes through 5 links, and 4 intermediate nodes. Each of the links is a 10 Km optical fiber with a rate of 10 Mbps (assume speed of light in optical fiber is 2.0×10^8m/s). The 4 intermediate nodes are store-and-forward devices, and each intermediate node must perform a 50 μs routing table look up after receiving a packet and before it can begin sending it on the outgoing link. How long does it take to send the entire file across the network?

ii. If the data link layer can detect errors between hops, why do you think that we need another checking mechanism at the transport layer?

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?

iv. Decompose the problem of airline travel into a series of layers. Define the functions of each layer along with the addition/removal of headers information that is added to passengers and baggage as they move down/up the airline protocol stack?

2.

a. ((2+2+3+2)+2+(3+3)+3)

i. A colony is set up in moon. The 10 Mbps link from the earth to the lunar colony measures about 242000 miles. Assume that the signal propagation speed is 186000 miles per second. Calculate the minimum round-trip time (RTT) for the link. Calculate the delay*bandwidth product for the link. If a camera on the lunar base sends 25 Mbyte image file to the earth as a sequence of 1 Kbyte packets, how many bits are needed for the sequence number if we assume the use of a sliding window protocol? What is the window size and buffer size at both sender and receiver?

ii. Apply bit unstuffing to the sequence:

01111110000111101111101111101100111111110

iii. A Let $g(x)=x^3+x+1$. Consider the information sequence 1001.

a. Find the bit stream that will be transmitted.

b. Suppose that a transmission error occur in the first bit. What does the receiver obtain wh does its error checking?

iv. Consider an ARQ protocol that uses only negative acknowledgements (NAKs), but no posi acknowledgements (ACKs). Describe what timeout value would have to be scheduled. Explain why an A based protocol is usually preferred to a NAK-based protocol.

b. (3+4+3+6+4)

i. One data link protocol designer has argued that it is wasteful to end each frame with a flag byte and then b the next one with a second flag byte. One flag byte could do the job as well, and a byte saved is a byte ear Do you agree?

ii. Find the CRC for data stream 1010101010 using generator 10011.

iii. A sender and a receiver use a Sliding window protocol with 5-bit sequence number. The sequence num starts from 0. What is the sequence number after sending 100 frames?

iv. Consider a communication channel with bit rate 10 Mbps and round trip propagation delay of 10 m Suppose that 32 bit sequence numbers are used to transmit blocks of 1000 bytes. How long does it take for sequence number to wrap around?

v. Suppose that instead of Go-Back-N ARQ, N simultaneous Stop-and-Wait ARQ processes are run in para over the same transmission line. Each frame is assigned to one of the N processes that is currently idle. T processes that have frames to send take turns transmitting in round-robin fashion. The frames carry sequence number as well as an ID identifying which ARQ process the frame belongs to. How does the serv offered by this protocol differ from the service offered by Go-Back-N ARQ?

3.

a. (8+3+6+3)

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

ii. In LAN A 10 computers are connected using hub and in LAN B using switch. Which LAN do you prefer a why?

iii. Let's consider the operation of a learning switch in the context of a network in which 6 nodes labeled through F are star connected into an Ethernet switch. Suppose that *(i)* B sends a frame to E, *(ii)* E replies with frame to B, *(iii)* A sends a frame to B, *(iv)* B replies with a frame to A. The switch table is initially emp Show the state of the switch table before and after each of these events. For each of these events, identify t link(s) on which the transmitted frame will be forwarded, and briefly justify your answers.

iv. Suppose that a group of workstations is connected to an Ethernet LAN. If the workstations communicate on with each other, does it make sense to use IP in the workstations? Should the workstations run TCP direct over Ethernet? How is addressing handled?

b. (5+2+4+6+3)

i. There are 10 stations in a time slotted LAN always having constant load and ready to transmit. During a particular contention slot each station transmits with a probability of 0.1. If the average frame takes 122 ms transmit, what is the channel efficiency, if round trip time is 51.2 micro seconds.

ii. An IP packet to be transmitted by Ethernet is 60 bytes long, including all its headers. If LLC is not in use, padding needed in the Ethernet frame, and if so, how many bytes?

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

iv. A ring network runs at 1 Mbps and has a length of 1000 meters. The speed of signal propagation is 2x1 m/sec. How much time a frame of 1000 bits will take to round the ring? Will the frame arrive back to th station before the station completes its transmission? What should the minimum size of the ring so that leadin edge of the frame does not return back before the station completes its transmission?

v. In CSMA/CD, after the fifth collision, what is the probability that a node chooses a random value k=4? What will be the corresponding delay (in sec) for k=4 on a 10 Mbps Ethernet.

4.

a. (5+3+5+4+3)

i. Host A sends a UDP datagram containing 8880 bytes of user data to host B over an Ethernet LAN. Ethernet frames may carry data up to 1500 bytes (i.e. MTU = 1500 bytes). Size of UDP header is 8 bytes and size of IP heard is 20 bytes. There is no option field in IP header. How many IP fragments will be transmitted and what will be the contents of offset field and total length field for all fragments?

ii. Let us consider the following subnet mask. Find out its class and the number of subnets.
11111111 11111111 11000000 000000

iii. An organization has been assigned the prefix 212.1.1.0/24 and wants to form subnets for four departments, with hosts as follows:

A	75 hosts
B	35 hosts
C	20 hosts
D	18 hosts

1. Give a possible arrangement of subnet masks to make this possible.
2. Suggest what the organization might do if department D grows to 32 hosts.

iv. Suppose that a datagram network has a routing algorithm that generates routing tables so that there are two disjoint paths between every source and destination that is attached to the network. Identify the benefits of this approach. What problems are introduced with this approach?

v. 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?

b. (3+3+3+6+3+2)

i. As a possible congestion control mechanism in a network using virtual circuits internally, a router could refrain from acknowledging a received packet until (1) it knows its last transmission along the virtual circuit was received successfully and (2) it has a free buffer. For simplicity, assume that the routers use a stop-and-wait protocol and that each virtual circuit has one buffer dedicated to it for each direction of traffic. If it takes T sec to transmit a packet (data or acknowledgement) and there are n routers on the path, what is the rate at which packets are delivered to the destination host? Assume that transmission errors are rare and that the host-router connection is infinitely fast.

ii. Suppose a small ISP X pays a larger ISP A to connect him to the rest of the Internet and also pays another ISP B to provide a fall-back connection to the Internet in the event that he losses connectivity via ISP A. ISP X learns of a path to some prefix via ISP A, should he advertise that path to ISP B? Why or why not?

iii. Determine whether or not the following IPv6 address notations are correct:
::0F53:6382:AB00:67DB:BB27:7332
7803:42F2:::88EC:D4BA:B75D:11CD
::4BA8:95CC::DB97:4EAB

iv. 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.

v. You are given the following address: 153.50.6.27/25. Determine subnet mask, subnet address, and broadcast address.

vi. Computer A sends a packet to computer B with port number 1000. There is no process running at port number 1000 in computer B. What action computer B will take?

5.

a. (9+4+3+4)

i. Source A uses TCP Reno to transfer a file of 9 KB to destination B. Each packet has a payload of 1KB. Assume that only two packets are lost during the transfer: the 4th data packet and the acknowledgment of the 6th data packet. Draw a time diagram of the entire file transfer. Assume that retransmission timeout is 4*RTT. How many RTTs does it take to transfer the entire file? Ignore the connection setup, processing and transmission times.

ii. Host A sends a TCP segment (Sequence number=43, Acknowledge number=103) with payload of 14 bytes. The host B successfully received the segment and wants to send a segment with payload of 14 bytes. What will be the value of Sequence number and acknowledgement number field in the reply from host B? Assume that host A sends the first segment to the host B after connection setup.

iii. A sender on a TCP connection that receives a 0 advertised window periodically probes the receiver to discover when the window becomes nonzero. Why would the receiver need an extra timer if it were responsible for reporting that its advertised window had become nonzero (i.e., if the sender did not probe)?

iv. The Nagle algorithm, built into most TCP implementations, requires the sender to hold a partial segment's worth of data (even if PUSHed) until either a full segment accumulates or the most recent outstanding ACK arrives. Suppose that mouse position changes are being sent over the connection. Assuming that multiple position changes are sent each RTT, how would a user perceive the mouse motion with and without the Nagle algorithm?

b. (2+7+4+3+4)

i. Suppose a user has two browser applications active at the same time and suppose that the applications are accessing the same server to retrieve HTTP documents at the same time. How does the server tell the difference between two applications?

ii. Consider a window controlled transfer over a connection with a RTT of 200 ms. The bottleneck link speed on the path is 2 Mbps. The data packet length is 1000 bytes. Assume that there is only one connection over the bottleneck link.

   a. Determine the minimum window (in number of packets) required so that the bottleneck link is fully utilized (ignore the ACK transmission times).
   b. If a window of 20 packets is used, determine the maximum possible utilization of the bottleneck link.
   c. What happens if a window of 80 packets is used?

iii. If the receiver window is 24 KB and MSS is 2 KB, calculate the time elapses before the full burst of TCP segments amounting 24KB is released by the sender if slow start is used as congestion control mechanism. Assume round trip delay of 50 ms.

iv. Why do we use delayed acknowledgement and how?

v. What do you mean by fast retransmit and fast recovery algorithm?