Ref No: Ex/IT/T/225/2017

Bachelor of Information Technology 2nd Year 2nd Semester Examination 2017

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

i. Three post offices cooperate to provide postal service. They are interconnected by mail vans which carry the mail. At each post office three processes are carried out in order to provide the postal service.

1. Collection of mail from service users
2. Sorting of mail
3. Packing of mail for the other post offices

Draw a layered model of the postal department. Define the functions and services provided by each layer. Assume that the mail packing department hands over the mail to the mail van. How a letter posted within the same postal area is processed?

ii. In a network with distributed multiplexing using random access, assume that the distance between all node pairs is *d*. Give example of physical networks in which this could be possible.

iii. Hosts A and B are each connected to a switch S via 100 Mbps links. The propagation delay on each link is 20 μs. S is a store-and-forward device; it begins transmitting a received packet 35 μs after it has finished receiving it. Calculate the total time required to transmit 10000 bits from A to B if two 500 bit packets sent one right after the other.

b. (3+4+10+3)

i. Can a connection oriented, reliable message transfer service be provided across a connectionless packet switched network? Explain.

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. 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.

iv. Assume that a voice channel occupies a bandwidth of 4 KHz. We need to multiplex 12 voice channels with guard bands of 500 Hz using FDM. Calculate the required bandwidth.

2.

a. (6+6+4+4)

i. 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.

ii. A bit stream 10011101 is transmitted using the standard CRC method. The generator polynomial is $x^3 + 1$. Show the actual bit string transmitted. Suppose the third bit from the left is inverted during transmission. Show that this error is detected at the receiver's end.

iii. Suppose that a Stop-and-Wait ARQ system has a timeout value that is less than the time required to receive an acknowledgement. Sketch the sequence of frame exchanges that transpire between two stations when station A sends five frames to station B and no error occur during transmission.

iv. We almost always put the CRC at the end of a frame. What advantage do we get from this policy?

b. (8+4+3+5)

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

Station A sends frames 0-6. Station B receives them in order, but frame 2 and 4 were damaged.

ii. A network layer packet is split into 10 frames, each of which has an 80 percent chance of arriving undamage If no error control is done by the data link protocol, how many times must the message be sent on average get the entire thing through?

iii. In stop-and-wait ARQ, what happens if a negative acknowledgement is lost in transit? Why is there no need f such acknowledgements to be numbered?

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

1. An interactive application produces a packet to send each keystroke from the client; the serv 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 numb of full-size packets that are to be transferred to the client.

3.

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

i. Suppose a large network uses transparent bridges to connect all network segments. A computer on this bridg network sends out a packet to a device that is not present on the network. What do the bridges do with tl packet?

ii. Suppose n stations compete for the access to a shared medium using ALOHA protocol. The probability that Station transmits a frame is p. Find out the probability that a transmission becomes successful. What is tl mean number of transmissions required to successfully transmit a frame? What is the line efficiency?

iii. Ethernet is sometimes said to be inappropriate for real time computing because the worst case retransmissic interval is not bounded. Under what circumstances can the same argument be leveled at the token ring? Und what circumstances does the token ring have a known worst case? Assume the number of stations on the toke ring is fixed and known.

iv. Suppose two 10 Mbps Ethernet LANs each containing N/2 stations are connected by a bridge. Assume that tl efficiency of each Ethernet is 80 percent. Also assume that each station transmits frames at the average rate 100 Kbps and each frame is equally likely to be destined to any station. What is the maximum number stations N that can be supported in this extended Ethernet?

v. Consider a 1 Mbps 2km token ring network with 10 stations including a monitoring station. The propagatic speed of the signal is $2 \times 10^8$ m/s and the token transmission time is ignored. If each station is allowed to ho the token for 2 μsec, what is the minimum time for which the monitoring station should wait before assumir that the token is lost?

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

i. The IT department of J.U. has 3 Ethernet segments, connected by two transparent bridges into a linear networ One day the network administrator quits and is replaced by a person from computer center who is an expert token ring. The new administrator, noticing that the ends of the network are not connected, quickly orders new transparent bridge and connects both loose ends to it, making a closed ring. What happens next?

ii. Imagine two LAN bridges, both connecting a pair of 802.4 networks. The first bridge is faced with 1000 51 byte frame per second that must be forwarded. The second is faced with 200 4096 byte frames per secon Which bridge do you think will need the faster CPU? Discuss.

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

iv. Ethernet frames must be at least 64 bytes long to ensure that the transmitter is still going in the event of a collision at the far end of the cable. Fast Ethernet has the same 64 byte minimum frame size, can get the bits out ten times faster. How is it possible to maintain the same minimum frame size?

v. 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. (5+2+4+2+2+5)

i. What are the two approaches to packet switching? Distinguish between them.

ii. IP, ARP, IGMP and ICMP all run in network layer. How does a computer know if an arriving frame contains an IP datagram or an ARP message or an IGMP packet or an ICMP packet?

iii. The IP network 192.168.130.0 is using the subnet mask 255.255.255.224. What subnet are the following hosts on?

192.168.130.67, 192.168.130.222, 192.168.130.250

iv. Can we use a single bit subnet? Explain.

v. What is the difference between flow control and congestion control?

vi. A router has the following routes in its routing table:

| Route | Outgoing Interface |
|---|---|
| 10.0.0.0/8 | E0 |
| 10.0.0.0/16 | E1 |
| 10.0.1.0/24 | S0 |
| 10.1.1.0/24 | S1 |
| 10.1.0.0/16 | S0 |
| 10.1.0.0/24 | E1 |
| 10.1.1.1/32 | S2 |

A packet arrives at the router with a destination address of 10.1.1.1. Which interface will the router use to forward that packet?

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

i. Consider three IP networks A, B, and C. Host $H_A$ in network A sends messages each containing 180 bytes of application data to a host $H_C$ in network C. The TCP layer prefixes a 20 byte header to the message. This passes through an intermediate network B. The maximum packet size, including 20 byte IP header, in each network is 1000, 100, and 1000 bytes respectively. The network A and network B are connected through a 1 Mbps link, while B and C are connected by a 512 kbps link. Assuming that the packets are correctly delivered, how many bytes, including headers are delivered to the IP layer at the destination for one application message, in the best case? What is the rate at which application data is transferred to host $H_C$?

ii. 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?

iii. Suppose P, Q, and R are network service providers with respective CIDR address allocations C1.0.0.0/8, C2.0.0.0/8, and C3.0.0.0/8. Each provider's customers initially receive address allocations that are a subset of the provider's. P has the following customers:

PA, with allocation C1.A3.0.0/16
PB, with allocation C1.B0.0.0/12

Q has the following customers:
QA, with allocation C2.0A.10.0/20
QB, with allocation C2.0B.0.0/16

Assume there are no other providers or customers. Also assume P is connected to Q and Q is connected to R, but P and R are not directly connected. Give tables for P and R.

iv. Congestion control is better implementing in network layer, but Internet is implementing it in the transport layer. Why?

v. 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?

5.

a. (3+2+7+3+3+2)

i. A TCP connection is opened with slow start. Estimate the number of round trip times required to send *n* TCP segments.

ii. In addition to having acknowledgement field in the TCP header, ACK bit is also provided. What would happen if the ACK bit were not provided?

iii. Suppose you are transferring a file of 10 MB over a network, which has a capacity of 20 MB and 50 msec one-way delay. The packet size used in network is 1 KB. The initial slow start threshold is set to 10 MB. What is the effective throughput achievable for TCP?

iv. Lost TCP acknowledgements do not necessarily force retransmissions. Explain why?

v. 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?

vi. Define the purpose of the following fields in TCP header:

URG, SYN

b. (8+4+2+6)

i. Assume that TCP implements an extension that allows window sizes much larger than 64 KB. Suppose that you are using this extended TCP over a 1-Gbps link with a latency of 50ms to transfer a 10 MB file, and the TCP receive window is 1 MB. If TCP sends 1-KB packets, how many RTTs does it take until slow start opens the send window to 1 MB? How many RTTs does it take to send the file? Assume no congestion and no lost packets.

ii. When does a TCP receiver generates duplicate acknowledgements and how these acknowledgements are interpreted by the TCP sender?

iii. "TCP is a Byte stream not a message stream". Why?

iv. You are hired to design a reliable byte-stream protocol that uses a sliding window (like TCP). This protocol will run over a 1-Gbps network. The RTT of the network is 100ms, and the maximum segment lifetime is 30 seconds. How many bits would you include in the window size and sequence number fields of your protocol?